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THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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☞ An asterisk (*) denotes an illustrated article

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WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

Subscribers would confer a favor upon us by remitting *CHECKS*, or *POST OFFICE MONEY ORDERS*, as we are frequent losers where money is enclosed in letters.

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TO THE MEMBERS OF THE AMERICAN GAS-LIGHT ASSOCIATION.

OFFICE OF THE AMERICAN GAS-LIGHT ASSOCIATION, 117 BROADWAY, NEW YORK.

The Annual Meeting of the American Gas-Light Association will be held in this city in the month of October next. At no time in the history of gas making, in this country, has it been so important as at the present for those to whose hands are entrusted the very large interests involved, to take wise, thoughtful, and harmonious council together. The progress and improvements that have been made by individual effort in the past, render it all the more urgent for those of the profession who are associated together for mutual improvement, to make a careful examination of results thus far obtained, and by becoming more thoroughly posted upon the actual present condition of the business, see wherein deficiencies exist, and wherein still greater improvements may be made.

In the present depressed condition of all business, economy in every expenditure is forced upon consumer and manufacturer alike. Cheaper gas is demanded as well as a lower price for every other article of daily consumption. While in some instances the relative cost of kerosene has induced consumers to take the chances of the danger and inconvenience resulting from its use, simply because of its price.

These are practical questions, and they are best met by a thorough understanding of the business in which we are engaged.

To this end it is important that each member of the Association should commence, if he has not already done so, to collect and arrange facts and figures in their experience, on the several subject matters to be brought up for discussion at the next meeting, so that, from the volume of information that may be thus brought together, each may see wherein greater economy may be reached in his manufacture, and be enabled to meet, as far as can be reasonably demanded, the requirements of the times.

The following subjects of a practical character have been selected for discussion at the October meeting, viz.:

1. The use of gas for other than illuminating purposes.
2. Deterioration of coal from the time it is mined to the time it is used in retorts.
3. Retort Settings.
4. Condensation.
5. Purification.
6. Distribution and Service.
7. Holders and Apparatus.
8. Burners.
9. Meters.
10. Enrichers.
11. Residual Products.

Each member of the Association is especially requested to make such record as he may be able on some one or more of the above subjects.

If any member desires to discuss other topics, he is not to feel that the consideration of the foregoing subjects is to exclude him from presenting any matter of interest or benefit to the Association. By each and every one giving the results of their own observations, and the facts considered to be established thereby, the best gas knowledge of the engineers of America may be developed and put into substantial form for the benefit, use, and profit of all.

These are the objects and purposes of the Association, and it is most respectfully urged upon every member to contribute to make the next meeting a profitable one, and to make our Association second to none at home or abroad.

CHAS. NETTLETON,
Secretary American Gas-Light Association.

WEST OF SCOTLAND ASSOCIATION OF GAS MANAGERS.

The Fourth Annual Meeting of this Association was held on April 27th, at Greenock. Mr. W. Dunlop, the President of the Association, in the course of his address, referred to the subject of Exhausters, and the effect of barometric pressure on the quantity and illuminating power of gas that may be taken from a ton of coal—claiming that coal used at high elevations should give a larger yield and increased illuminating power over that carbonized at the level of the sea, owing to the diminished atmospheric pressure, by which the gas becomes more expanded, and, when thus expanded, is able to take up more of the naphtha vapors from the tar. This caused some discussion which we will give in our next. But it is our desire more particularly to call the attention of our readers to the general remarks at the opening of Mr. Dunlop's address.

This West of Scotland Association was formed only four or five years ago, and those of our readers who have studied some of the papers we have published, taken from its proceedings, must have been impressed with the fact that our Scotch friends are in earnest in seeking the real and true

advancement of their profession, and that they have the good fortune to have among their membership men who give to the consideration of the Science all the energy and scientific investigation of which they are capable. They seem to be proud of their profession, and determined to elevate it to the position to which it is entitled. We quote from the President's address:—

"Gentlemen: At the close of another season's labors we have assembled for the interchange of opinion—for the diffusion of that knowledge that has come to us by experience—and to gather from each other such information as will be for the advancement of our profession, the perfection of which we so much desire, in order that, if possible, the defects which at present exist in our apparatus may, to some degree, be remedied and that more improved appliances may be called into play; and further that our defects and successes may be made known to each other, so that from these the timid and fearful may take courage, while the already prominent may, with increasing vigor, pursue their search into the hidden mysteries of Nature which have so long lain undeveloped. The development of our branch of engineering has not kept pace with the advancement of other branches. There has been progress made in gas manufacture, as many facts show. Ingenious mechanical arrangements have been brought into use which have lessened the expenditure, increased the revenues, and have given dividends to companies who, for years upon years, had their energies taxed to the utmost to make both ends meet.

"Nor at the same time was this success so much due to ourselves as to others. It was the discovery and extraction of various chemical compounds contained in the tars, and the corresponding increase in their value, which to a great extent accomplished this end, so that while we have made progress, at the same time the fact still remains that there have not been the same decided substantial improvements in our branch as in others. It still holds true that we have fallen behind our friends in point of advancement. As a proof of this take for instance the manufacture of paraffine oil. Its manufacture has developed with such extraordinary rapidity that the manufacturers are able to compete with the proprietors of oil wells.

"Then look at railways and bridges and it needs no demonstration to show that in these branches there has been a complete revolution. But as for our branch no such thorough revolution has taken place. The coal is still thrown into the retort as before, lime is still the principal material for purification, the liquor is still to a great extent unutilized, and the holders are as a rule of the same or kindred construction, so that gas manufacture is conducted on the same old monstrous and expensive routine as it was forty years ago.

"But now that associations of gas managers are general—now that one gas manager does not look with suspicion on his neighbor manager—now that these prejudices have disappeared, and that mutual intercourse has been established—now that there is no more of that close-mindedness and isolation which so long characterized our profession, there seems to be a brighter future for us. More cheering prospects are in view and the time is surely close at hand when the existing state of matters shall have ceased to be, and when new and better things shall occupy their place. This (the advancement of gas manufacture) being the grand aim of our, and like, associations, it is for them and for us to exert ourselves to the very utmost, and to strive to attain unto and usher in this brighter future, remembering that the sooner this is done the better will it be for us and for the world at large; therefore, let no one present hesitate to express his opinion, but take courage and give utterance to his thoughts, that light may be shed upon the subjects for to-day's consideration. And may I express the hope that the discussions which may follow the reading of the various papers shall have the effect of awakening among us, and others, a more lively interest in the subjects, and that other and superior minds may take up the strain, and carry it onward and forward till it reaches perfection."

Here we have set forth, in clear terms, the aims and objects and advantages of associations. It is to be feared that in this country the great advantage to be derived from meeting together in this way is not duly appreciated. We trust that at the next meeting of the American Association we shall see developed a deeper and more constant interest than ever before, and that the programme suggested in the communication of the Secretary will be carried out in such a manner as to show at least exactly where we stand to-day, and as we progress, from year to year, we can, by looking back, see exactly what progress we are making. We have minds fully competent to discuss the various subjects, and all that is wanted is a little united action to bring out and put on record the facts, as well as the theories, of gas manufacture.

Let every one select and arrange well-ascertained facts, in his own experience, on one or more of the topics proposed for discussion, and when all these are brought together a starting-point at least will be established.

MR. SUGG'S ILLUMINATING POWER METER.

We give on another page a full description of Mr. Sugg's new instrument. For the cut accompanying it we are indebted to the courtesy of Mr. Wm. B. King, of the London *Journal of Gas-Lighting*, who kindly forwarded us the "electro" to enable us to give our readers a full and complete idea of the new invention, which we feel confident is going to prove another valuable contribution to the gas maker from the hands of Mr. Sugg, who has already done so much to advance the science of gas-making.

There is one of these instruments on Exhibition at Philadelphia. It will be found in Machinery Hall, in the British Department, together with other things of interest exhibited there by Mr. Sugg. The American Meter Company are agents for Mr. Sugg in this country.

☞ Mr. George Chaloner, F.C.S., Editor of *Iron*, London, is in this country to visit the Exhibition. We know of no paper devoted to the interest of any specialty that is more ably conducted, and we wish for the Editor of *Iron* a pleasant visit, and trust that he will find himself amply repaid for crossing the Atlantic. We regret exceedingly that the stagnation in the Iron trade will cause his visit to be less interesting in matters outside the Exhibition than it might have been if times were not quite so dull.

The Polytechnic Review, of Philadelphia, for May, comes to us filled with matters of interest. The Editors of this Journal, Professors Wahl and Grimshaw, are more than making good the promises in their prospectus. This is No. IV of Volume I of their enterprise, and the whole arrangement and matter reflect the highest credit upon the managers. Among other things we notice a full description of the Langen & Otto gas motor, fully illustrated. These are working at the Exhibition in Philadelphia.

Centennial Correspondence.

To the Gas-Light Journal:

Globe Hotel,
Philadelphia, May 25, 1876.

As all your readers are aware, from the daily press, the Exhibition is now well under way; it has been open fifteen days, and the change that has come over the face of everything connected with it is something almost like magic. Although at the opening it was admitted that everything was in a more forward state of readiness than has been usual on similar occasions with other Exhibitions, still it was after all somewhat like moving into a new house—there remained much to be done. The way in which that which was left to be done is being accomplished is the best evidence that could be asked, or obtained, of the efficiency and thoroughness of the management.

It is in vain that any attempt may be made to belittle or detract from the greatness of the exhibition. It is and will be a success. As a display of the handiwork and industry of the world it has never been equalled, and this is not the opinion of the writer alone, but of many with whom he has conversed that have had the privilege of seeing the London, Paris and Vienna Exhibitions.

Every American may take an honest and honorable pride in this affair, and should if the thing is in any way possible, visit it at some time. There need be no delay about going (for those who can go) for there is much more to be seen than most of your readers will be able to observe in the time which they will spend there. A few hints as to the best way of seeing what is to be seen. The first thing after arriving is to get located somewhere. There is every provision made for the accommodation of all that come, and there seems to be a determination on the part of every one that there shall be no "sticking it on" to strangers. Large hotels have been built near the Park, where many thousands may be taken care of at fair rates. This hotel (the Globe) is just opposite the main entrance, has over a thousand rooms, is newly furnished throughout, and provides as good a table as any in the country; the charges are the same as the Fifth Avenue or Windsor hotels in your city. If cheaper places are desired they are to be had. One hotel advertises rooms at $1 per day, and meals *a la carte*. Or lodgings with breakfast can be had in private houses at from $2 to $2.50 per day.

If one has but a few days to spend here he should by all means stay near the grounds, in preference to going into the city, for it is cooler, just as cheap, and saves much time and labor in getting to and from the exhibition.

Having located, the next thing is to provide yourself with half a dollar, either paper or silver, and join the vast throng pouring into the gates, and now let no one deceive himself by thinking it is not work to see the show. Whatever course is pursued a good pair of legs, in good walking order, are the most essential thing to have now. To get a good general idea of the "lay of the land," a ride on the narrow-gauge railroad, for which the fare is five cents, will be of assistance. This road is well-equipped; but a great deal of very poor judgment has been shown in locating and arranging some of the stations. Awnings are yet unprovided for the platforms, and some of the stations are located on steep grades and sharp curves combined, and in one case the curve is a reverse curve; this will doubtless be remedied for the engines cannot properly perform their work, and somebody will probably find out the reason why. This matter of locating the stations

is the worst bit of engineering about the whole grounds. The principle buildings to be visited are the main building, where may be found the handiwork of all nations—this has over 21 acres of flooring. Machinery Hall, covering 14 acres; the Government Building, where every department of the Government is represented; Agricultural Hall, containing the fruits of the earth, and the products thereof, together with implements and machines connected with their cultivation. The Art Building, where may be seen some of the best specimens of the Art of all Nations. Some of these have "annexes," or supplementary buildings, which are placed near by from the fact that the principle ones could not afford the proper space. As we were strolling down the main building the other day, we noticed in the British department some of Crooke's Radiometers, among the articles displayed by Mr. J. Hicks, of Hatton Garden, London. Mr. Hicks took great pleasure in explaining it to us, he having made the first one for Mr. Crooks in London. One of these may be seen at Mr. Gall's, optician, Union Square, in your city. Mr. Hicks also showed us some of his hydrometers, made with graduated enamel stems, and also gas and water pressure guages, with a strip of white enamel at the back of the tube, and graduations worked on the front. These tubes, when containing water, appear as white milk up to the top of the water, and like ordinary glass above it, enabling one to see from a distance just where the pressure stands. Near by the London *Graphic* has a printing press at work, the motive power being a gas engine of Prussian invention—the Otto and Langen.

The American Society of Civil Engineers have head quarters in the gallery at west end of the main building, and here may be seen some things of interest to gas men. But I suppose that your readers would find more familiar names in machinery hall than anywhere else, for there many of your advertisers have most complete and beautiful displays. The meter men shine forth in all the beauty of that apparatus which is ever at the command, and in the service of, the intelligent gas-maker.

I cannot now go into the details, but W. W. Goodwin & Co., Harris, Griffin & Co., and others, are familiar names over displays that no American gas maker need be ashamed of. Roots, (Exhausters), Morris, Tasker & Co., Gloucester Iron Works, Starr & Co., McNeals & Archer, Chapman Valve Company, Ludlow Valve Company, and others, names all familiar to your readers, are as usual on hand and ready for business. The Springfield Gas Machine Company have a display of workmanship that is fully up to their well-earned reputation. I did not intend to use names in this letter, but among the great crowd one ever rejoices to meet a familiar friend and must speak. I hope from time to time to keep your readers posted as to what is going on here that may be of interest to them.

DELTA.

On New Determinations of the Velocity of Light.

[Proceedings of the Royal Society.]

The old philosophers and astronomers, until Galileo, thought that the propagation of light was instantaneous.

Astronomical Determination of the Velocity of Light.—Rœmer, a Danish Astronomer, called to the Paris Observatory by the illustrious Picard, after having computed from some old observations the eclipse times of Jupiter's satellites, found great discrepancies between the calculated and observed times; the eclipses appear too soon when Jupiter approaches the earth and too late when it goes away. Rœmer ascribed these differences to the time necessary for the propagation of light, and concluded from his observations that light requires about eight minutes to come from the sun to the earth.

Bradley, one of the most illustrious English astronomers, seeking to put in evidence certain small annual motions of the stars caused by the displacement of the earth in space (annual parallax), found such a motion, but quite different from the expected one. The apparent deflection of the direction of a star—for instance, *y* Draconis, near the pole of the eliptic—instead of being at every moment directed, as expected, towards the centre of the terrestial orbit (the sun) is directed at a right angle. The greatest elongation (called *aberration*) rises to 40·7″ from six to six months. Bradley, after many attempts, ascribed this effect to the composition of the velocity of light with the velocity of the elliptic motion of the earth (1728).

From those observations, and from the approximate knowledge of the distance from the sun to the earth, the velocity of light was found equal to about 200,000 English miles in a second, in other terms, one million times the velocity of sound.

Direct Determinations of the Velocity of Light were for a long time considered as impossible, owing to the enormous value of this velocity. The first solution was given by M. Fizeau (1849) by the method of the toothed wheel.

Induced by some considerations analogous to the celebrated *acces theory* of Newton, M. Fizeau, one of the most illustrious members of the Paris Academy, and recently elected honorary member of the Royal Society, succeeded in rendering perceptible and even measurable the duration of the propagation of light for a distance of a few miles.

The principle of the method is the following;

A beam of light passes through the interval between two teeth of a rotative toothed wheel (*roue dentee*): this beam is reflected on a mirror fixed some miles distant, comes back exactly on the same line, and passes again through the same interval as before. An observer can receive this beam: he will see a luminous point, a luminous echo, through each hollow between two teeth; if the wheel revolves with an increasing speed the luminous impression will first become continuous. The wheel will soon revolve with sufficient rapidity to turn a small angle during the time necessary for the beam of light to go and come back again. The angular velocity can be so regulated that the solid part of a tooth is substituted for the hollow part during this time; then, on coming back, the beam will be obstructed by the wheel. The same obstruction will take place at each tooth, and the luminous echo will disappear.

If the velocity of the wheel be doubled, the luminous point will appear again, because the reflected beams will meet with the following hollow and pass through. With a triple velocity a new extinction will take place, as before.

The following apparatus is necessary to produce the exact reflection of the beam:—At each station a telescope is directed to aim at the centre of the object glass of the opposite station. The beam of light is sent through the first telescope; the pencil of rays, rendered nearly parallel, is received by the second and concentrated in its focus, and there reflected by a small mirror. After reflection, the rays follow exactly the same path, and come back at the very point they start from. The observer can receive these return rays without being blinded by the source of light, by interposition of a piece of transparent glass, which reflects a good part of these return rays.

Apparatus for Extinguishing Fires in Theatres.

Through the courtesy of Dr. Schilling, of the "Journal fur Gasbeleuchtung," we have received a pamphlet describing an apparatus for extinguishing fires in theatres. We give the following extracts, translated for the AMERICAN GAS-LIGHT JOURNAL by T. H. Muller.

The pamphlet gives an illustration of the working of the method, and it is strongly endorsed by Dr. Schilling.

"The peculiar construction of the machinery and decorations for a large stage, where vertical members, sometimes of large area, hang closely together, render such a room in case of fire almost like a number of chimneys; so that, even with the best trained fireman, and the best possible disposition of hose, it is impossible to check much less to control and extinguish a fire.

"Commencing in 1868, the inspector of the Royal Theatre, Mr. Charles Glehle, proposed, therefore, to protect against fire by means of properly distributed pipes, perforated in such a manner that the water from sufficiently large tanks is distributed over the stage in the form of a very heavy rain shower, so as to soak every combustible part in an instant. An experiment made on a small scale gave such good results, that it was concluded to protect the stage in this manner, and the gas company was charged with the execution thereof.

"The leading points in the construction of this extinguishing apparatus were the following:

"1. From the plane of the tie-rods in the roof-frames a very intense rainshower is produced, either over the whole of the stage, about 800 square meters, or over one-third thereof, by means of as simple motions as possible—the levers or handles to be on the stage, easily accessible, as well as on the gallery on either side of the stage, 18 meters above the same.

"2. The quantity of water at disposition in the tanks must be sufficient to produce this intense rain over the whole stage for at least 3 minutes, or over one-third of it for 10 minutes.

"3. The moving parts must be so constructed that they will not rust, stick, etc., and that the handles of the levers can only be reached by the properly instructed watchman.

"Under these conditions there were placed 9 pipes across the stage, under the roof-frames, provided on the lower side with holes about 3-32 of an inch in diameter, in 9 rows, so that the two upper rows lay in the horizontal diameter. These pipes are connected by two valves, lifted from below, with two mains one on each side of the house. The valves are plain checks, with the stem passing through the bottom of the chest, and resting on a double armed lever, the other end of which is connected by a ¼-inch wire with the levers, and these levers are always keyed on one shaft so as to move simultaneously.

"There are also provided proper valves, etc., to empty the tanks, which are placed on the separating wall between stage and auditorium, above the proscenium.

"On the 29th of January a trial was made with the two rear sections. in presence of a large and select company of distinguished persons, when the valves for these two sections were opened for 30 seconds, during which time 3,200 litres of water were discharged on the stage. Although there was no fire, every one present was convinced that even the strongest fire would have been extinguished in a few seconds.

"For small fires the old hose apparatus is to be used."

Sugg's Illuminating Power Meter.

[From "London Journal of Gas-Lighting," April 25, 1876.]

In February last, Mr. Sugg read a paper before the Institution of Civil Engineers on "Estimating the Illuminating Power of Coal Gas," and we are indebted to that gentleman for the following description of the illuminating power meter which he then exhibited.

This instrument has been designed by the inventor principally for the purpose of aiding engineers in the examination of coal, and other substances suitable for gas-making. It is intended to test the illuminating quality of all gases under similar circumstances, and to show the relative commercial value of these gases to the consumer.

ILLUMINATING POWER METER, FOR SHOWING THE ILLUMINATING POWER OF GAS IN PARLIAMENTARY SPERM CANDLES, BY THE OBSERVATION OF ONE MINUTE.

The annexed engraving shows the appearance of the instrument, and the following is a description of its construction and the mode of using it:

A "London" Argand burner, provided with a well-made cylindrical chimney, is fixed, by means of a ground swivel joint, on the top of a pillar screwed on to a hollow rectangular base, which is firmly soldered to the outer case of an experimental meter. This base has no communication with the inside of the meter-case. That part of the pillar between the top of the base and the burner forms a cock, the gas-way of which is not drilled in the usual manner, but is slotted across the plug. The sides of this gas-way being parallel to each other, it follows that, unlike those cocks fitted with round-way plugs, the cock opens when the lever is turned by regular gradations until it is full open. A quadrant, divided into 45 equal divisions, attached to the cock, enables the operator to regulate the flow of the gas to any required rate with rapidity and precision. Above the quadrant a sighting frame is fixed, having two upright pillars, crossed by a flat bar at one end, and at the opposite end a frame fitted with blue glass. A scratch is made across the glass exactly three inches above the solid part of the frame. The bottom of the opening, the top of the burner, and the termination of the thick part of the back columns are all on the same level. The scratch on the glass, and the bar which crosses the back pillars, are also on the same level, and parallel to the three lower points just mentioned. By these arrangements the operator is enabled to adjust the height of the flame to the level of the scratch and the back bar.

It may be observed, in passing, that if some points in the flame pass the line by about one-eighth of an inch, it will make but a very slight difference to the result. There will always be small points which wil look like flame, but which are only heated air. A few minutes practice will suffice to enable any one, without previous knowledge of the instrument, to adjust the height of the flame.

On the left side of the hollow base on which the pillar stands is a tube which connects this base to the outlet of a double governor. The square box on the left of the meter is this governor, which serves to maintain uniformity of pressure during the time the instrument is in use. This governor is adjusted so as to give pressure enough to make the flame tail over the chimney when the regulating-cock is full open.

On the right of the hollow base is fixed a two-way cock, with a lever ending in a knob fixed to its plug. The cock is quarter stopped, so that when it is turned in one direction as far as the stop it is full open, and in communication with the inside of the meter, which is full of measured gas. In this position this measured gas passes through the length of the plug of the cock, and by means of a tube fixed to the end of the cock at one end, and to the inlet of the double governor at the other, it finds its way through the governor to the hollow base, and finally to the burner. While the gas is passing to the burner by this route, the measuring-drum of the meter revolves; but if the lever of the cock is turned in the opposite direction until it meets the stop, another route is opened for the passage of the gas. Now it passes directly from the inlet of the meter without passing into the measuring-drum through the length of the plug of the cock, and out by the same tube as before to the inlet of the governor, thence to find its way to the hollow base and the burner. In this position of the lever the measuring-drum of the meter is at rest, and the gas is unmeasured. The governor having been properly adjusted, and the meter having from 8-10ths to one inch of pressure at its inlet, this change in the position of the lever will not influence the height of the flame.

The index-hand is attached to the arbor of the measuring-drum, and therefore revolves with it, both making a revolution in the same time. The dial is divided into a number of divisions corresponding with the illuminating power in average parliamentary standard sperm candles, of the different qualities of gas which will give a flame of 3 inches in height. Thus, if the meter is supplied with 16 candle-gas, and the flame is maintained at 3 inches, the index-hand will make one complete revolution in one minute. If the meter is supplied with 12-candle gas, and the flame maintained at the 3-inch line, the hand will make one revolution, and a part of another, arriving at the figure 12 in one minute. With 20-candle gas it will make less than a complete revolution in one minute, and arrive at 20. The instrument is provided with a very accurate and strong minute clock, with one pointer hand, which makes a complete circuit of the small dial in one minute. This dial is divided into 60 equal divisions, representing seconds.

On the right of the cylinder which forms the outside case of the meter is the water-line gauge, fitted with back and front glasses. At the correct water-line these glasses are scratched across. On the top of the water-gauge is a large nut, which can be unscrewed when it is required to fill the meter or gauge-glasses. The plug at the lower part of the gauge is for the purpose of running out the water if there is too much in the meter.

In the base of the meter is a cock for the purpose of emptying all the water out of it, when it is requisite to do so. This meter should never be turned upside down for the purpose of emptying, or some water will get into the meter and connections, and probably cause trouble. For the purpose of filling the meter, a solution of one part of good glycerine, free from acid, in three parts of distilled water, should be used.

The mode of putting it into operation is very simple. Having filled the meter up to the water-line scratched on the glass, connect it to the gas supply with a piece of metal tube. The inlet is a ground union joint, fixed in the centre of the back of the instrument. Turn the lever so as to make the gas pass through the measuring-drum, and let it get rid of all the air or other kind of gas in it. Light the burner and adjust the flame to three inches in height. Then, when the large hand arrives at 16, change the position of the lever, so as to make the gas pass to the burner without going through the measuring-drum. The large hand will then stop at 16. Wind up the clock by means of the *remontoir* on the top of the meter just in rear of the dial ring. Start the clock by moving the slide which is on the left of the meter, close to the governor. Then, when the hand of the clock is passing any one of the divisions of the minute, change the position of the lever of the bye-pass, so as make the gas pass through the meter. When the minute hand has made one complete revolution, stop the meter by means of the lever, in the manner before described, and read off the illuminating power. The minute clock should not be stopped either before or after the observation, unless it is desired to put the clock entirely at rest.

Referring to the abstract of the paper on estimating the illuminating power of coal gas, read at the Institute of Civil Engineers, and published in the London *Journal of Gas-Lighting* of Feb. 22d last, it will be seen that it is very difficult, according to the present system of testing for illuminating power, to arrive at a just appreciation of the relative value for lighting purposes of different qualities of gas made from different mixtures of coal. The various standard burners differing one from the other in almost every point, coupled with the uncertain light-giving power of the standard sperm candles, tend to impede, and in some cases entirely to prevent the carrying out of any really useful comparisons.

Of course, these difficulties are not generally so apparent when it is a question of verifying the illuminating power of gas supplied to the public under the usual parliamentary conditions. Custom has established that the variations between the tests made by the public officer at his official testing-place, and those made by the seller of gas at the gas-works, may be considered to range between one and two candles. And this is set down as resulting from various causes. So that it is generally assumed that if the gas is sent out of the gas-works two candles more in illuminating power than that stipulated for in the Act of Parliament or contract, the seller is in no danger of falling under the pains and penalties to which he is liable whenever the illuminating power is found by the official examiner to be below the standard. Proofs are not wanting however, that this mode of ensuring against accidents is not an infallible one. Probably, it would be safe enough if it could be at all times certain that the gas is really sent out two candles over the standard. But in many cases the testings made at the gas-works are done by comparison with sperm candles. The errors caused by the different degrees of illuminating power per grain of material consumed given by different candles, are sometimes in favor of, and at other times against, the gas. If, therefore, these errors are in the same direction on the same day at the gas-works and at the official testing-station, there will, in all probability, be some accord between the two operators. But, on the other hand, they may go in different directions, and then the results will be very conflicting.

Both parties having made the experiments carefully, t becomes a matter of extreme difficulty to decide which is right. Not even a strict examination of the details of the experiment, will avail in some cases to afford any clue to the discovery of the error. The causes which have led to the discrepancy may be these—the gas at the works may not be properly consumed in the standard burner, and the candles may be giving more light per grain of material consumed than they ought. The introduction of a small quantity of paraffine or petroleum into the sperm, or the diminution of the quantity of wax which is always mixed with sperm to prevent it from crystallizing, or, as it is technically termed, to break the grain, will certainly do this. This combination will make the gas appear to be o f a lower quality than it really is. But upon its passage from the work, to the testing-station, if the movement is slow, some of the illuminating agents in the gas will be deposited in the mains, and there will be some loss of illuminating power. Under such circumstances, the official test ought not to show so high a result as that taken at the works. But the official burner, of which that at the works is a copy, will be better able to burn the stipulated 5 cubic feet of poorer gas to advantage than that at the works could the richer; and, if the official candles happen to give a light nearer to the ideal standard than those before mentioned, it is certain that the gas examiner's estimation of the gas will be higher than that of the seller. From such a cause, perhaps, arises the curious circumstance of an apparent increase of illuminating power in the passage of gas from the works to the testing-office. A variation in some of these circumstances in other directions may lead to a result nothing like so agreeable, and a considerable diminution of illuminating power may be observed on another occasion at the same testing-place at which the opposite result has been recorded. The gas, however, may be quite equal in quality to that which was in the first instance so favorably reported upon. On the other hand, the seller may be deceived in his examination of the gas he is sending out of the works by candles which give less light per grain of material consumed than they should, and thus be led to suppose that it is better than it really is. Bad cotton, or even good cotton badly plaited, or the admixture of stearine with the sperm, or an extra quantity of wax —all very difficult to detect—will produce this result.

In all cases when the gas going out from a work is tested by means of a Lowe's jet photometer, the engineer is enabled to check these irregularities, and to ascertain, with a very great degree of certainty the real value of the gas he is supplying to the public. But the official examiner has no such aid, and he is quite unable to determine whether the results he obtains are correct or not. Naturally, so long as the gas arrives at the testing-station two candles above the stipulated quality, the probability is that he will not find it to be below the parliamentary standard. But if he does, and makes complaint of it, then comes the difficulty. A comparison of the testings at the gas-works with the official tests must be made.

It has been proved, on several occasions, that the gas which had been found by the official test defective in illuminating power, has shown itself above, and sometimes considerably above, the parliamentary standard by the indications of the identical jet photometer, which, on most occasions before, agreed reasonably well with comparison test made at the works, and that by the official examiner. Doubts are entertained, therefore, by both parties as to the value of each other's experiments, when really, from the careful manner in which the tests have been made on both sides, there ought not to have been any discord ance in the results. It has been suggested that if the official testing apparatus included a Lowe's jet pho tometer, much difficulty would be obviated; because then the official tester would be able to check the results obtained by the comparison photometer, and could try over again, with other candles, any experiment which in the result disagreed with the observed illuminating power shown by the Lowe's jet photme ter. The goodness of this suggestion has been, in those cases in which it has been acted upon, satisfac torily demonstrated; and the official examiner has been enabled to detect erroneous results by means of this check. No notice, however, is ever taken in official returns of the indications of the jet photometer, because it has never, in this country, been sanctioned as a parliamentary test, and no mention of such a mode of testing has ever been made in any Act of Parliament. Perhaps the time may come when it will be deemed advisable, in all gas Acts, to provide a check test for the illuminating power of gas, in addition to the usual specification of the testing-burner and parliamentary candles. When that time does come, the jet photometer or the illuminating-power meter may be advantageously adopted for the purpose.

This last-mentioned instrument is of immense service to the jet photometer, because by it the accuracy of the latter instrument can be verified, at all times, in another way than by comparison with a standard Lowe's jet photometer; and, what is of still greater importance, the indications of the jet can be put in direct comparison with other systems of ascertaining illuminating power in a manner more certain and satisfactory than has hitherto been attainable. The great difficulty which has always prevented the strict accordance of the tabulation of the indications of the illuminating power, as shown by the jet photometer, with the results of experiments conducted by means of comparison photometers, has been, up to the present time, the variations in the standard burners made use of. These remarks more particularly apply to gases above or below 14 candles, as tested by the Sugg-Letheby burner.

The general adoption of this burner for testing 14-candle gas permitted of the accurate adjustment of the jet for the estimation of this quality of gas. By taking the average of a great number of experiments with different sperm candles, a mean of illuminating power was found, which agreed very nearly with the results of independent experiments conducted by M. Le Blanc, the chief municipal gas examiner of Paris. It was, therefore, assumed that, when a jet of fixed dimensions furnished a flame of 7 inches in height, under a pressure of 0·63 of an inch of water, the gas which was able to supply this flame was equal to 14 average sperm canndles, comparison being made with 5 cubic feet of gas consumed on the Sugg-Letheby burner. This assumption has been considered as well-founded by numerous independent experimentalists in various parts of the world, who have made use of Kirkham and Sugg's improved Lowe's jet photometers thus rated.

The adoption of "the London burner" by the Metropolitan Gas Referees led to the abandonment of the Sugg-Letheby burner, as a standard testing burner, in most of the cities and towns throughout the world where it had been in use, and to the substitution for it of that adopted by the Gas Referees. This change affected the position of the 14-candle line on the jet photometer chart, and another line had to be found for it, which was very easily done. But, after quitting the 14-candle line on the chart, the comparison of the Lowe's jet with the results obtained by official examiners, working under the various Acts of Parliament, becomes much more difficult. The reason is, that there is no regularly adopted series of standard burners which develop a *pro rata* amount of light, in comparison with the Gas Referees "London" burner, per cubic foot of gas consumed. The three 16-candle standard burners described in Acts of Parliament differ amongst themselves considerably, and there is only one 18-candle burner, but this is not in any better case, as regards comparison with the Gas Referees standard burner for fourteen-candle gas.

These exhaust the list of standard Argand burners. For 20-candle gas, flat-flame burners are made use of, and two entirely different burners of this kind have been sanctioned by Parliament—viz., that adopted by the Gas Referees, and which is called "Sugg's No. 7 steatite bat's-wing," a slit burner, and the Dublin fish-tail, or double-current burner. The former of these consumes the gas at 2-10ths, and the other at 5-10ths of an inch of water at the point of ignition. Our readers need not be told that the results obtained by their aid differ widely. Beyond 20-candle gas there are no recognized standard burners.

Mr. Kirkham and Mr. Sugg, in making their experiments for the purpose of establishing a comparison between the readings of the jet photometer and the parliamentary tests, were obliged to make burners which would consume 5 cubic feet of the different qualities of gas, and their improvised test-burners accorded very well with each other; hence the regularity of the scale. But they labored under the disadvantage of not having so full an acquaintance with the principles which rule the development of the latent luminosity in gas as they now possess, and, therefore, although they quite established their belief in the principle, that all quantities of gas could be made, by the aid of proper burners, to develop a *pro rata* amount of light per cubic foot of gas consumed, they did not succeed in carrying their ideas into practical effect to such an extent as they desired. But upon the experience gained in these experiments are founded the ideas which led to the construction of the illuminating power meter, in which it is sought to provide a means of more correctly estimating the light-giving power of gases, and to compare them with each other without having recourse to the doubtful aid of candles, and with only one standard burner for all qualities of gas. But even this wholesale sweeping away of troublesome elements does not completely clear the ground for fresh operations. The estimation of gases up to 18 candles has always been made by the aid of Argand burners. The 10 and 12-candle burners of the times preceeding 1850 were Argands; the Sugg-Letheby of 1863, for 14-candle gas, the Dublin, for 16-candle gas, and the Leamington, for 18-candle gas, are also Argands. But for gases of 20 candles and upwards, the rule has been to employ a fish-tail or flat-flame burner. Here is a difficulty. Gas which is 20 candle gas when tested by a flat-flame burner, is about 18 candle when tested by such a burner as the the Gas Referees "London." But if the edge and flat of the flat flame be alternately presented to the disc, and a mean result of the light given from both positions taken as the true illuminating power it will be found to be a little over 18 candles.

Again, if gas which has been tested and found to be equal to 18 candles by the Leamington Argand burner (15 holes, with steatite top and 7 inch by 2 inch chimney) be again tested, the Gas Referees cannel flat-flame for 20-candle gas having been substituted for the Leamington burner, the result will be about 22 candles. The reason for this is that the Leamington burner does not develop the illuminating power of the gas supplied to it, and, in consequence, if it is required to give gas equal to 18 candles measured by this burner, a mixture of coal must be put into the retorts which is capable of producing gas which will give the light of 22 candles per 5 cubic feet, measured by the Gas Referees "London" burner, with a modified form of cone and chimney-holder, which permits of three currents of air being supplied to the flame. The object of these modifications is to permit the flame to burn in the chimney in a current of air sufficient to supply it with a proper quantity of oxygen for its combustion, without permitting the chimney to draw in too much air against the flame itself, or in other words to decrease the rapidity of the column of air moving up the chimney to such a point as will be sufficient to keep the column of flame upright, and leave the burning gas to take the quantity of oxygen it requires in a natural way. The effect of this modification is to develop the illuminating power of the gas to a greater extent than is done by the Gas Referees "London" burner.

Such burners are made for and extensively used by consumers, and are not made for testing purposes at all. If one of these burners is used as a test-burner for 20-candle gas, the results are equal to those obtained when the Gas Referees flat-flame burner is used, although for 27 to 35-candle gases they fall a little below the results arrived at by the use of large

flat-flame burners. But it is only fair to say that as these burners are generally very smoky, no consumer could burn gas in that way; besides which, the results obtained are fictitious, because only the flat of the flame is presented to the disc.

If a flat-flame burner is used for testing gas, and the flat of the flame always presented to the disc, the graduation of the photometer-bar ought to be arranged accordingly, in order that the results obtained may correspond with those arrived at in testing gas of 18-candle power and under. In these latter experiments a standard is made use of, which gives light equally in all directions, in conformity with the principles upon which the calculations for dividing photometer scales are based.

It may reasonably be asked why gas of 20-candle power and upwards should not be tested in the same manner as qualities below that standard. The illuminating power meter, as the inventor proposes to use it, with only one burner and a 6½ inch chimney, will be found to give a rather more favorable result for gases of 12 to 18 candles, and a less favorable one for those above 20 candles, comparison being made with some of the modes at present in use for testing the light-giving power of these gases. But, *per contra*, all the gases will be tested in the same manner, and as the private consumer can use them, and the amount of light given will be in volume and intensity such as to thoroughly satisfy him. At the same time the instrument will afford a fair indication of the result which would be obtained, were any of the gases tested in accordance with the usual practice, and with the aid of any of the present legal standard burners.

On the dial opposite the number of candles of illuminating power, corresponding with the result which these several burners would show, will be marked a star, designating the kind of standard burner which will produce that result when it is burning gas at the rate of 5 cubic feet per hour. Thus the illuminating power meter will serve as a gauge instrument, showing the real value, from a consumer's point of view, of the gas tested by it, and, at the same time, as a guide to the engineer, of what he may reasonably expect will be the number of candles which will figure in the report of the official gas examiner, who will make his tests with the parliamentary apparatus at the testing-station.

Those of our readers who possess Kirkham and Sugg's Lowe's jet photometers will doubtless appreciate at once the advantage of having an appratus by which they can check the working of these instruments, and satisfy themselves whether they are in good working order without the trouble of sending them to be compared with any standard jet photometers. For with this new instrument the check test is threefold. Firstly, the amount of light given by the 5-inch flame can be verified by taking the average of a number of observations by the aid of the comparison photometer with fair parliamentary sperm candles; secondly, the indication of the illuminating power meter can be compared with those of the jet photometer; and thirdly, the test may be made with the aid of candles and the usual parliamentary standard burner on the comparison photometer. Having once satisfied himself of the accuracy of his instruments, the engineer will be able at any moment to ascertain what kind of gas he is making by a glance at the jet photometer, or in a two or three minutes consultation with the illuminating power meter; the working of any quality of coal can be accurately and rapidly checked, and the supply to the district kept uniform in quality from hour to hour.

It is probable that the new instrument will not be received with favor by the producing staff of a gas-work, excepting as an occasional check upon their Lowe's jet photometers. They have such confidence in the accuracy of these instruments, engendered by constant familiarity with them, which is in the highest degree flattering, encourages the hope that when, with the aid of the new instrument, the range of scale may be extended and verified with greater precision than has hitherto been possible, owing to the want of suitable standard burners for the richer gases, the number of those who consult them will be very largely increasing.

It may be fairly claimed for Lowe's jet photometers, that they have done more towards assisting engineers to satisfy the wants of the public, by supplying gas of regular illuminating power, than any other apparatus in use on gas works, and it is hoped that the illuminating power meter will be found equally as efficient as a check test to the jet photometer, and a means of enabling the engineer to compare different samples of coal with each other, and ascertain the relative value of gas produced from them to the consumer.

It has been said of the jet photomer that it is an empirical test, and that although it is intelligible to those who understand it, it does not impress the mind of the consumer with the fact that the values given in the chart as being the illuminating power of gases, after the observed height of the flame under certain pressures, are reliable. The same cannot be said of the illuminating power meter. The standard light' equal to 16 sperm candles, from which its indications are deduced, is measurable by the eye and by comparison with other lights, and the quantity of gas which furnishes this standard is measured by the instrument, the highest value being accorded to the gas which affords this light with the smallest quantity.

[One of these instruments will be shown at the Exhibition of Scientific Apparatus, Kensington, and one has been sent to the Exhibition in Philadelphia.]

Some Methods of Estimating the Illuminating Power and Purity of Coal-Gas.

By A. VERNON HARCOURT, M.A., F.R.S.

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[From the Journal of the Society of Arts.]

[Concluded from page 208.]

Direct observations of the illuminating power of different samples of gas have hitherto been made by a judgment of the eye, comparing under conditions favorable to exact observation the relative brightness of the flame produced by the sample of gas and of a standard light.

But two problems remain, a satisfactory solution of each of which is more necessary to the establishment of a trustworthy system of photometry than the substitution for the disc of some more absolute criterion of illuminating power.

The first problem is, what standard shall be used in testing the illuminating power of coal gas.

The present unit, as defined by Act of Parliament, is a sperm candle of six to the lb., burning 120 grains an hour. This is convenient as an unit, since the light given by different lamps and gas-burners may be described, without the use of high numbers or of decimals, as a light of 10, or 15, or 20 candles. But without further definition it is by no means satisfactory as a standard, since the light which a candle gives depends not only upon the material of which it is made and the rate at which it burns, but also upon the construction of the wick. Some differences of opinion exist among those experienced in candle photometry as to the extent of fluctuation to which the results thus obtained are liable. According to my own experience, sets of observations made one after the other with the same sample of gas, and with candles from the same packet, often agree very closely, and seldom differ to the extent of one candle. Occasionally, however, without any apparent cause, the results are more divergent; and I have found a considerable difference in the results and in the degree of uniformity with different packets of candles obtained from different dealers. What the burner is to gas, its wick is to a candle; and just as the definition of the illuminating power of gas has been unsettled by improvements in the burner used for testing, so it may also be altered by the application of similar attention and skill, on the part of the candle maker, to the conditions under which the maximum illuminating power can be developed from the combustion of 120 grains of sperm per hour.

If it be possible, as I hope to show that it is, to furnish a more constant standard of comparison for artificial lights than the sperm candle, the term candle might still be retained as the name of an unit otherwise defined, just as "foot" has come to be the name of an exact measure.

In Paris the photometric standard is the Carcel lamp, burning colza oil at a given rate. Some years ago Mr. Keates proposed the use of sperm oil, and I understand that such a lamp has recently been constructed on an improved principle by him and Mr. Sugg. I have not personally made trial of any of these lamps, but probably they give a light more constant and more comparable with that of a gas flame than is the light given by a pair of candles. At the same time, the very fact that an improved form of lamp has recently been constructed—if, as I believe, the improvement relates not only to the constancy but to the illuminating power of the lamp—suggests the likelihood that one standard lamp might differ in some degree from another, and that further improvements might gradually creep in. With a lamp, as with a candle, the wick is a most important element and one which it is exceedingly hard to fix or define.

It was to meet the uncertainty as to the construction of the wick—and also that as to the composition or purity of the liquid fuel—that Mr. Crookes devised this little lamp which he has kindly lent me. Its wick consists of a certain number of platinum wires of a certain size. The liquid which burns is a mixture of two pure substances—alcohol and benzol. The light is said to be much more constant than that of a candle; but the flame in its present form is too small to be conveniently compared with that obtained from gas burning at the rate of five cubic feet an hour.

At present, I think it must be admitted that the problem of devising a satisfactory photometric standard, which can easily be obtained at different places, and is easily applied, and is such that when prepared with due care, absolute confidence may be placed in its uniformity, has still to be solved.

Upon this problem I have been working at intervals during the last two or three years, and though I am still occupied with the work and have not yet completed it, I may be permitted to lay before you the results at which I have arrived, and to show what would be the operations required for testing the illuminating power of coal gas under the system which I propose.

In place of candles or lamps I propose to use a standard gas. As no single gas exists which is suitable, a mixture of gases must be employed; and that which I believe to be most suitable is a mixture of hydrogen with pentane or with pentane and hexane. The two substances last named constitute the most volatile portion of American petroleum. Under the pressure of one atmosphere pentane is a liquid at temperatures below 30° C., and hexane at temperatures below 68° C.; but under a pressure of one-tenth of an atmosphere, and probably under somewhat greater pressures, both these substances are gases. To reduce the pressure upon them, and also to reduce their illuminating power to that of ordinary coal gas, they must be mixed with another gas. I have tried both air and hydrogen for this purpose, and I prefer hydrogen for the following reasons. A smaller quantity of petroleum, in about the proportion of two to three, is needed with hydrogen than with air for the same illuminating power, and thus the petroleum gas is under a less pressure, and further from its point of condensation. The gas prepared with hydrogen has about the same specific gravity as coal gas, and therefore presumably, the same burner is suitable for both, whereas the gas prepared with air is, of course, heavier than air. In preparing the standard gas with air a meter must be used to measure its volume, and corrections applied for the variations of barometer and thermometer, whereas by acting on an excess of zinc with a known weight of sulphuric acid a quantity of hydrogen is obtained, which is accurately known without the need of either measurement or correction.

The following, according to Cahours, are the constituents of petroleum boiling below 100° C.;

Pentane, C_5H_{12}, sp. gr. at 17° C., 0·628, boiling point, 30°.

Hexane, $C_6 H_{14}$, sp. gr. at 16° C., 0·669, boiling point, 68°.

Heptane, $C_7 H_{16}$, sp. gr. at 16° C., 0·6995, boiling point, 92° to 94°.

Starting with the lightest petroleum which is obtainable commercially, I have rectified it with the following results. The composition of the samples is calculated on the supposition, which is probably nearly correct, that by rectification below 65° heptane may be excluded.

Petroleum rectified below 45° sp. gr. at 15°, 0.635.
" " 45°—55° sp. gr. " 0·647.
" " 55°—65° sp. gr. " 0·664.
" " below 65° sp. gr. " 0·646.

		Below 45°8	45°-55°	55°-65°	Bel. 95°
Composition of samples	Pentane	82·9	53·7	12·2	56·1
	Hexane	17·1	46·3	87·8	43·9

The proportion of hydrogen, which must be added to the hydrocarbons to produce gas of constant illuminating power, will vary slightly according to the composition, or specific gravity, of the sample of petroleum employed. It is on this point chiefly, a point of capital importance, that I need still to make further experiments. I have worked chiefly with th sample whose specific gravity is 0·646.

To prepare standard gas I employ the following apparatus: A flask of from 3 to 4 litres capacity, into the mouth of which a thistle-funnel and elbow-tube pass through a plug of india-rubber; a wash-bottle of about a litre capacity; a gas-holder capable of containing 7 or 8 cubic feet; one or more graduated vessels fer measuring out the required quantity of dilute sulphuric acid; a Winchester quart, fitted with pinch-cock and inlet tube for air, to hold the measured quantity of acid and deliver it by degrees into the generating flask; a pipette of 70 or 100 cubic centimeters capacity, to measure the required dose of petroleum, and deliver it into the wash-bottle.

The operation of preparing standard gas is as follows: The flask is filled one-third with granulated zinc, and connected with the wash-bottle, two-thirds of which is filled with water. About 100 cubic centimeters of dilute acid is first poured upon the zinc, which generates sufficient hydrogen to sweep out air from the flask. When the evolution of hydrogen has ceased, which requires about half an hour, the wash-bottle is opened, and the pipetteful of petroleum discharged into it, after which the wash-bottle is at once closed and connected with the gasholder. The Winchester quart, holding the measured volume of dilute acid, is supported in an inverted position, and its pinch-cock is so adjusted that the acid may flow in a rapid succession of drops into the generating flask. Hydrogen passes in a rapid stream through the water in the wash bottle and through the layer of petroleum which floats upon the surface of the water, and the mixed gases pass on into the holder. From this point the operation needs no further attention. When all the acid has run in, the evolution of hydrogen gradually diminishes, and almost ceases by the time that the liquid, heated by the action, has become cold. The gasholder then contains the whole of the petroleum which was taken, and a quantity of hydrogen which is also exactly known, since the sulphuric acid has saturated itself with zinc and consequently has yielded 4-49th its weight of hydrogen.

The water in the wash-bottle serves to prevent any acid spray passing to the holder, to provide a level floor for the evaporation of the petroleum, and to furnish the heat which the petroleum needs to pass from the liquid to the gaseous state. The absorption of heat, as the petroleum volatilises, reduces the temperature of the contents of the wash-bottle considerably below that of the surrounding air. Consequently the standard gas is formed at a temperature below that to which it is afterwards subjected. In spite of this reduction of temperature, the whole of the petroleum has generally disappeared when two-thirds of the hydrogen has passed over. Consequently the standard gas is formed under a pressure exceeding by at least one-fourth that to which it is afterwards subected. It is therefore a permanent gas under any onditions to which it is likely to be exposed.

I have here two similar tubes, standing vertically in a vessel of water, which have been filled to the same level, one with air, the other with standard gas When ice is placed round them, so that their temperature falls to 0°, the contraction is the same in both cases, showing that the standard gas behaves like a permanent gas, and that no liquid petroleum is condensed out of it.

The dilute sulphuric acid which I have employed has the specific gravity 1·217, and contains 0·352 grains of pure sulphuric acid in one cubic centimeter. It may be made, approximately, by mixing 26 5 volumes of oil of vitriol with 100 volumes of water. The strength of the dilute acid is unimportant, provided it be exactly known, and provided it is not such that sulphate of zinc crystallises out and hinders the action of the acid.

It will be seen that the adjustment of the illuminating power of the gas is thus practically brought, with an acid of known strength and a particular sample of petroleum, to a question of rightly proportioning the volume of acid to the volume of petroleum. The following are some of the results I have obtained with acid of the above mentioned strength and petroleum distilled below 65° and having the specific gravity 0·636. The numbers given under the head of illuminating power are in most cases the mean of four or five different sets of observations made with different samples of standard gas prepared according to the same recipe.

Vol. of Dilute Acid. So. Gr 1·248.	Weight of pure Sulphuric Acid.	Weight of Hydrogen.	Weight of Petroleum	Ratio of Petroleum to Hydrogen by weight.	Illuminating power (candles).
cc.	Grams.	Grams.	Grams.		
1680	593	12·07	45·22	3·75	14·5
1640	579	11·78	...	3·84	15·2
1315	570	11·6	...	3·9	15·9
1610	568	11·57	...	3·91	15·97
1605	567	11·53	...	3·92	16·1
1580	558	11·35	...	3·98	16·6

Hence it appears that a mixture of one part by weight of hydrogen and 3·91 parts by weight of light petroleum, form a gas of 16 candles' illuminating power. I propose the use of this gas as a photometric standard. It consists of 90·9 volumes of hydrogen and 9·1 volumes of gaseous petroleum. It contains in one litre 0·265 grains of carbon. It is easily prepared of constant composition, and in any required quantity.

I have still to determine what modification needs to be made in the proportion of hydrogen, that is, of dilute acid employed, with samples of petroleum of different specific gravities. Probably it will be possible to connect by a simple formula the specific gravity of any sample of light petroleum with the proportion of sulphuric acid which must be used with that sample, in order to furnish 16-candle standard gas.

It remains for me to describe briefly the form of photometer which Mr. F. W. Hartly has arranged for me, in which to compare the sample of gas to be tested with the standard gas. It corresponds to the ordinary open photometer, with a 60-inch bar, except in the following particulars.

Both ends are furnished with similar "London" argand burners, with the usual appliances for measuring and regulating the current of gas, all in duplicate. By a suitable arrangement of cocks either sample of gas may be sent into either meter, and thus to either burner. The center line of the bar is numbered 16, and two scales having this line in common are drawn out, one beneath the other, so that the position of the pointer which travels with the disc can be read upon each.

One scale is to be used when the standard gas is burning on the right, and indicates the value in candles of the gas compared with it; the second scale is the reversed image of the first (corresponding to it as the image of an object in a mirror does to the object), and is to be used when the standard gas is burning on the left. When a reading has been made on one scale, the samples of gas are to be reversed and a second reading made on the other scale. The geometric mean of these two readings is the true illuminating power of the sample of gas tested, depending for its accuracy upon the quality of the standard gas, but independent of variations of temperature and pressure, and of all inequalities in burners, meters, or disc.

Comparing thus directly one gas with another it is likely that the nature of the burners employed will make little, if any, difference, at least where the gas tested has nearly the same illuminating power as the standard gas. If so, an indirect but important advantage that would accrue from the adoption of this method is, that a question which has been hotly debated, as to what kind of burners ought to be employed in testing the illuminating power of gas, would disappear altogether.

The Supply of Gas to the Metropolis.

BY MR. HARRY CHUBB.

At the Ordinary Meeting of the Statistical Society on Tuesday, the 18th April, Mr. J. Heywood, the president, in the chair.

A paper was read by Mr. Harry Chubb, late secretary of the Imperial Gas Company. and now a director of the Gas-light and Coke Company, on "The Supply of Gas to the Metropolis," of which we give a very full summary.

INTRODUCTION.

The writer commenced by observing that the use of coal gas as a means of lighting has become so general, and the quantity required, for such an enormous city as London, is now so large that some statistics in connection with this important manufacture can scarcely fail to be of interest.

There were originally thirteen companies, but five of them have, within the last few years, amalgamated with others. These eight companies have seventeen manufactories, the sites of which have been selected chiefly for the facilities they afford of obtaining coals by water carriage. The share and loan capital of the united companies amount to rather more than eleven millions sterling, and the maximum rate of dividend allowed to be paid on the total share capital averages 8.7 per cent. There are, in the aggregate, upwards of a million and a half tons of coal used every year in the manufacture of gas in the metropolis, and the quantity of gas consumed amounted in the past year to about thirteen millions of thousands of cubic feet. There are at present 54,119 lamps in the public streets in the metropolis lighted by means of gas; and the mains of all the companies of various sizes, from four feet to three inches in diameter, reach the enormous length of upwards of 2000 miles.

This immense trade has risen up within the last sixty years. It was not until the year 1807 that any attempt was made to show that such a material could be applied with advantage for the purpose of lighting in the metropolis. In that year a small apparatus was set up in Pall Mall, and from it a few of the public lamps on one side of that street were supplied with gas in order to prove its practicability and its superiority over the system of lighting by the oil lamps then in use; but notwithstanding the undoubted success of that experiment, the scheme of thus lighting even the public thoroughfares was utterly condemned, and the use of gas in dwellings was denounced as unsafe, injurious, and impracticable.

Men of science joined in this opposition, and in ridiculing the idea as visionary. Even Sir Humphrey Davy, Sir Joseph Banks, and other celebrated men of the age, lent the powerful weight of their opinions and influence to check the proceding, and so great was the prejudice against the introduction of the new system into London, that it seemed at one time to present an insurmountable obstacle to its further progress.

The inventors, or rather those who appropriated the invention and adapted it to practical use, were, however, so fully persuaded of the great benefit and the improvement which their system of lighting would

effect, that they happily maintained their views, and ultimately, at great cost, and by dint of indomitable perseverance, worthy of all praise, prevailed with a sufficiently large section of the public to enable them to extend their operations.

HISTORY OF THE LONDON GAS COMPANIES.

In 1810, after two years of severe parliamentary struggle against powerful opposition, an Act was obtained, authorizing his majesty to grant a charter within three years to a company, for the purpose of lighting a small portion of the metropolis with inflammable gas, and under the powers of that Act the existing Chartered Gas-Light and Coke Company, the earliest of all the metropolitan gas companies, were established. That company lost no time in erecting a manufactory of very limited dimensions in Peter street, Westminster, then a wretchedly swampy district, frequently overflowed by the Thames, and on December 31, 1813, they commenced operations by lighting the lamps on Westminster Bridge. This became so great an attraction, that the bridge is said to have been quite a fashionable promenade whilst the novelty lasted.

The authorities of the small parish of St. Margaret's Westminster, next applied to have their streets thus lighted, and on April 1, 1814, the old oil-lamps in that parish gave place to the more brilliant light produced by coal gas.

Notwithstanding the evident improvement effected by the new mode of lighting the streets, the prejudice against its admission into shops and dwellings continued; so much so that the company, in order to obtain a trial, had, in the first instance, to furnish all the needful fittings, and supply the gas, free of expense. For nearly two years there was little or no increase in the consumption; and, in addition to the public prejudice, the difficulties the company had to contend with were many and serious, both in the manufacture and distribution of their gas. Their apparatus was necessarily most imperfect, their acquaintance with the science of gas purification was very limited, and the mode of constructing wrought-iron pipes by machinery being then unknown, the greatest difficulty was experienced in providing means for conveying gas from the mains in the streets to the houses to be supplied; for some time, indeed, old musket-barrels, attached to each other by screwing the muzzle of one into the breech of the other, were used for this purpose, and for many years afterwards, when machine-made wrought-iron pipes were introduced, they were called gun-barrel pipes from this circumstance. The cost of all fittings and material of every kind was also, at that time, so enormously high that the hindrances and embarrassments of the period must have been well-nigh overwhelming. They were, however, overcome; and when the Chartered Company had surmounted the principal difficulties, and opposition to the use of gas had somewhat abated, other companies were formed, who soon began to erect works in different parts of the metropolis.

The next undertaking, in succession to the Chartered, was the City of London Gas Company, which were incorporated in 1817, for the purpose as the name implies, of supplying the city of London. Then came the Imperial Company in 1821, seeking to serve the whole of the north side of London, north of Oxford street and Holborn, and outside the city.

Afterwards the following ten companies were established, viz.:

The Ratcliff, incorporated in	1823
The Phœnix "	1824
The Independent "	1829
The Equitable "	1831
The South Metropolitan, incorporated in	1842
The London, incorporated in	1844
The Commercial "	1847
The Great Central "	1848
The Western, not incorporated, but commenced operations in	1850
The Surrey Consumers, incorporated in	1854

In all thirteen companies.

In the first instance the companies had no exclusive privileges conferred upon them as to the monopoly of the supply in any district; they were also unrestrained as to the price they might charge, as well as the rate of dividend they might pay their shareholders on the capital invested.

Appended to the paper was the following table;

	Date of Establishment.	Date of Incorporation.	Prices charged for Gas per 1000 ft. at the commencement.
Chartered	...	1810	In 1823 when meters were first used, 15s
City of London	...	1817	1821, 15s.
Imperial	...	1821	1826, 15s.
Ratcliff	...	1823	1829, 12s. 6d.
Phœnix	...	1824	1824, 15s.
Independent	1826	1829	1829, 12s.
Equitable	...	1831	1831, 12s.
South Metropolitan	1834	1842	1834, 11s.
London	1833	1844	1834, 9s.
Commercial	...	1847	1850, 5s.
Great Central	...	1848	1848, 4s.
Western	1850	...	1850, 8s., cannel gas.
Surrey Consumers.	...	1854	— — —

NOTE.—Gas was originally supplied at per light. There were but few meters in use, between 1821 and 1825; they did not come into general use till about 1830.

The author proceeds to observe that not only was the question of price and dividend unrestricted, but the quality of the gas to be supplied was also left to the option of the companies, who were in no way bound to furnish a supply unless it suited them to do so.—*L. J. G. L.*

Practical Questions Settled about the Centennial Exhibition.

On the subject of hotel accomodations we have taken pains to inform ourselves and give as authority some extracts from the official report of John Welsh, Esq., President of the Board of Finance, which has just been published.

The report says: "At one moment great anxiety was felt lest there should be a scarcity of accommodations for visitors. It has been entirely removed. Hotels of very large capacity have been erected in the immediate vicinity of the Exhibition and throughout the city. Old ones have been enlarged, and by the agency of an enterprising association very large numbers of private dwellings, of which Philadelphia has sixty thousand more than any other American city, have been utilized for the purpose; so that under no probable circumstances can any inconvenience occur for want of comfortable accommodations.

"The strongest assurance is also felt that the charges will be moderate."

In the matter of the charge for admittance, a fifty-cent note paid at the gate admits to grounds, and there is no further charge. A visitor can enter one building or any of them as he sees proper. We quote the text of the report touching this question:

"In the arrangements connected with the entrance and exit of visitors, exhibitors, and employees, the greatest simplicity has been aimed at. Each class will use special gates. The ticket for visitors will be a *fifty-cent note*, and if not in the possession of the visitor it can be obtained in exchange for other money at an office near each gate of entrance. Children pay the same as adults. To vary from a uniform price entails so many inconveniences as to forbid it. Fifty cents for nine hours' visit to a museum of the products of the world, distributed among beautiful buildings and on grounds of surpassing attractions, must be satisfactory to every one. Such exhibitors and employees as are required on the grounds will be furnished with special tickets. Properly authorized representatives of the press, within reasonable limits, will be recognized as entitled to free admission."

The Iron Stand-Pipe of the Bloomington, Ill., water-works, just completed, is 225 feet high, eight in diameter, and holds nearly 100,000 gallons. It is said to be the largest in the world.

New Zealand Cable.—The submarine cable between New South Wales and New Zealand has been successfully laid.

Chemical and Scientific Repertory.

The mucilage used by the government for postage stamps is composed of dextrin two ounces, acetic acid one ounce, water five ounces, alcohol one ounce.

A new test-paper, invented by Waller, is prepared by soaking strips of white paper in a solution of coralline. It is exceedingly sensitive to the action of alkalies; very dilute alkaline liquids instantly turn it a beautiful red color. Acids turn it yellow; but, as the reaction is less striking, Dr. Waller proposes to use it only for alkalies, as a substitute for red litmus. —*Chemical News.*

PRESERVING PLANTS WITH THEIR COLORS.—A French gentleman, M. Boulade, has discovered that if freshly gathered plants are spread out between sheets of filtering paper in the usual herbarium manner, and then heated between two bricks in an oven for two or three hours at about 150° Fah., they will be perfectly and permanently preserved without impairment of the most delicate colors. The process is rendered more rapid and certain if the layer of filtering paper next the flowers be changed after about an hour.

VALUE OF THE SIGNAL SERVICE.—The great practical value of the signal service has never been more strikingly illustrated than during the continuance of a recent two days' storm along the New England coast. The operator at Thatcher's Island says that one hundred and thirteen vessels were in sight on the 21st at 2 o'clock in the afternoon, which put to sea when the storm signals were hoisted, and at the date of the dispatch no vessels were in sight. This fact is justly regarded as one of the greatest triumphs of the signal service since its establishment. The timely warning given enabled all these vessels to get a safe offing before the storm struck the coast. The great benefit to the commercial and material interests of the country by this service cannot be well exaggerated. The sphere of its usefulness seems also to be constantly enlarging.

RUSTING OF IRON.—It has usually been supposed that the rusting of iron depends principally upon moisture and oxygen. It would appear, however, from Dr. Calvert's experiments, that carbonic acid is the principal agent, and without this the other agencies have very little effect. Iron does not rust at all in dry oxygen, while it rusts very rapidly in a mixture of moist carbonic acid and oxygen. If a piece of bright iron be placed in water saturated with oxygen, it rusts very little; but if carbonic acid be present oxidation goes on so fast that a dark precipitate is produced in a very short time. It is said that bright iron placed in a solution of caustic alkali does not rust at all. The inference to be derived is, that by the exclusion of moist carbonic acid from contact with iron, rust can be very readily prevented.

"SOUNDING BRASS AND TINKLING CYMBALS."—A patent has recently been granted to Prof. Silliman, of New Haven, for a process of imparting resonance to Britannia, pewter, white metal and other alloys, which ordinarily give, when struck, only a dull leaden sound. The process consists in submitting articles formed of these alloys to the action of a regulated and well-determined temperature, just short of their melting point, for a brief but measured time. This is done in a bath of oil or paraffine, care being taken to avoid contact of water or even of a damp surface, which might cause a steam explosion, scattering the bath. All contact of the articles with metallic tools in the bath must also be avoided. If a rod of less fusible metal touch the alloy under such circumstances it cuts it like a soldering iron. The theory of the process appears to turn upon a rearrangement, perhaps a crystallization, of the molecular particles.—*Iron Age.*

COMPOSITION OF THE HUMAN BODY.—A complete

analysis of a man recently made by Dr. Lancaster, of London, has been described by him in a chemical lecture. The body operated upon weighed 158.4 lbs., and the lecturer exhibited upon the platform 23.1 lbs. carbon, 2.2 lbs. lime, 22.3 ounces phosphorous and about 1 ounce each of sodium, iron, potassium, magnesium and silicon. Dr. Lancaster apologised for not exhibiting 5585 cubic feet of oxygen, weighing 121 lbs., 105,000 cubic feet of hydrogen, weighing 15.4 lbs., and 52 cubic feet of nitrogen, likewise obtained from the body, on account of their great bulk. All of these elements combine into the following: 121 lbs. water, 16.5 lbs. gelatine, 52 lbs. fat, 8.8 lbs. fibrin and albumen, 7-7 lbs. phosphates of lime and other mineral substances.

A farmer who lives on the bank of the Delaware and Hudson Canal, near Homowark, having been annoyed by the boatmen throwing coal at his turkeys and chickens, has fixed poles in his field, and hung on them old hats, tin kettles, and bottles, at which the boatmen are constantly throwing coal. About once a week he gathers his harvest, which is enough for his own use; and with the surplus he is running a small coal yard.—*Coal Trade Journal.*

A Simple Safety Lamp.—For some time the police and night watchmen of Paris have been provided with a very simple safety lamp, which they are ordered to use in all shops and warehouses where inflammable materials are kept. A piece of phosphorous about the size of a pea is introduced into a strong glass bottle, and on this is poured warm olive oil, filling about one-third of the bottle, when it is closed with a tight fitting cork. When it is desired to use this lamp, the stopper is removed a moment, so as to give access to the air, when at once the empty space over the oil becomes luminous, and diffuses a light sufficient to find the way in the dark and see if things are all right. When the intensity of the light diminishes, it is sufficient to lift the stopper a single moment, when by the admission of atmospheric air the light is at once restored. Such a lamp can be used nightly for about six months, without undergoing any perceptible decrease in efficiency.—*Saward's Coal Trade Journal.*

The following results of analysis of Capledare (Scotch) Cannel coals, may interest our readers among the gas-light fraternity:

Gas per ton of coal, at 60° Fahr. and 30 inches barometric pressure	13,095 cub. feet
Illuminating power in standard sperm candles, by union jet consuming 5 cubic feet per hour, at five-inch pressure	32.91
Value of one cubic foot of gas in grains of sperm	780
Equivalent of a ton of coal in pounds of sperm candles	1,456
Durability of one cubic foot by five-inch flame	60 minutes.
Gravity of the gas (air=1000)	596

The Waverly Cannel mined by the same company showed:

Gas per ton of coal, at 60° Fahr. and 30 inches barometer	9,120 cub. feet.
Illuminating power in standard candles, by union jet consuming five cubic feet per hour, at five-inch pressure	36.62
Value of one cubic foot of gas in grains of sperm	878
Equivalent of a ton of coal in pounds of sperm candles	1,145
Durability of one cubic foot of gas by five-inch flame	80 minutes.
Gravity of the gas (air=1000)	677

—*Ibid.*

Valuable Deodorizer.—Dr. Goolden, in the London *Lancet*, directs attention to the value of chloride of lead as a deodorizer. He prepares it by dissolving half a drachm of nitrate of lead in a pint or more of boiling water, and pouring the solution into a bucket of water in which two drachms of chloride of sodium have been dissolved. When the sediment has subsided, the clear supernatent fluid is a saturated solution of chloride of lead. Dr. Goolden says that a cloth dipped in this solution, and hung up in a room, will instantly sweeten a fœtid atmosphere; or, if the solution be thrown down a sink, water closet or drain, or over a heap of dung or refuse, a like result will ensue. In this way he disinfected a house in which a drain had burst, some stables, and also a large ship. In the last case the bilge water was exceedingly offensive. He merely dissolved half an ounce of nitrate of lead in a bucket of boiling fresh water and had it thrown down the bilge when the ship was rolling slightly. The effect was the instant disappearance of all smell.—*American Engineer.*

Analyses of Natural Gas.—We are indebted to Prof. P. Sadtler, of the University of Pennsylvania, for the following summary of the results of his analyses and calorific calculations of the gases named. Prof. Sadtler's name is sufficient to give weight to the assertion that the analyses are correct. We regret that this reaches us at a time so near going to press as to prohibit further notice by us:

	Burns Well.	Leechburg Well.	Harvey Well.
Carbonic Acid	.34	.35	.66
Carbonic Oxide	trace	.26	trace
Illuminating Hydro-carbons	...	.56	...
Hydrogen	6.10	4.79	13.50
Marsh-gas (C H4)	75.44	82 65	80.10
Ethyl hydride (C2 H6)	18.12	4.38	5.72
Prophyl-hydride (C3 H8)	trace	trace	trace
Oxygen	...	...	...
Nitrogen	...	...	...
	100.00	100.00	99.99

SPECIFIC GRAVITY OF THE GASES.

Burns Well	6148
Leechburg Gas	5580
Harvey Well	5119

CALORIFIC CALCULATIONS.

Calorific Power (in heat units, centigrade).

Burns Well	14.211 units.
Leechburg Gas	14.105 "
Harvey Well	15.597 "

Calorific Intensity (theoretical temperature, centigrade, attainable by combustion in air).

Burns Well	2745° C.
Leechburg Gas	2749° C.
Harvey Well	2763° C.

—*American Manufacturer.*

Street Lettering.—A plan has been introduced in this country of having the plates displaying the designation of the streets of cities in cast-iron, the letters in relief being run at the same time in the mould; all that remains for the workman to do is to paint the border of the plate green, the ground blue, and the letters white, so as to give them the clear enamelled look they possess.—*Amer. Engineer.*

[A better arrangement than this is one used in Boston and some other places, viz., a light cast or malleable iron frame fits on to the street lantern, with the name of the street cast in solid letters, the light shines through the frame at night showing the name, and in the day time it is easily read, the glass of the lantern forming a light background for the dark letters.—Ed.]

Gas-Light Intelligence.

United States.

Natural Gas.—There are many questions still doubtful regarding the use of natural gas in Pittsburgh. One point is certain, that the well that is now utilized has not answered the expectations of those who laid the pipe line. Steps are being taken to make a thorough series of experiments regarding flow, etc.—*Iron Age, April* 27.

Gas for the County Buildings in Brooklyn.—This morning at 10 o'clock the Special Committee on Gas of the Board of Supervisors met at the Court House, Supervisor Clark in the chair, and opened bids from competing gas engineers. The following is a summary of the bids:

Eichholz & Green—Petroleum and Hydrogen process; $55,000 to furnish apparatus for all the county buildings.

James Austin & Co., apparatus for supply of county buildings and Penitentiary, $4,650. This is a crude petroleum process.

Maxim Air-Gas Machine Co., to furnish gas for all county buildings at $16,600 per annum, with county to have privilege of purchase at an additional sum of $16,700.

W. C. Wren—Crude Petroleum gas process. Two propositions. First—To build works at Morgue; to furnish Morgue, Jail and County Court House, and other works at Flatbush; to furnish County buildings and Penitentiary; complete works with buildings and all appliances $57,600. Second—To furnish the county gas for three years at the same total cost as at present and give the county the entire works at the end of three years. The cost of gas of 16 candle power is claimed to be 23 cents per thousand.

Centennial Oil Gas Co—Naphtha and Steam process, $22,220 for all of separate works at each of the county buildings, or $1.75 per thousand cubic feet.

General Rust for what is termed the Snake Hill process, petroleum and steam, for $34,000.

The committee have in their possession affidavits from the different bidders stating that gas of good quality can be made from 23 cents to $1.75 per thousand, but these statements and the bids will not be discussed or considered until an executive session is held by the committee.—*Brooklyn Times, May* 16.

May 23.—The Supervisors' Special Committee on Gas met this forenoon in executive session, to come to a determination in regard to adopting some one or the other of the proposals submitted for supplying gas to the county buildings; After remaining in consultation for an hour and a half, the committee adjourned without coming to any conclusion.

Great Britain.

Glasgow Gas.—We find that we rather underated the quality of Glasgow gas a week or two ago. The reports of Dr. Wallace show that its average illuminating power is over twenty-seven candles, and that as regards purity, its character is unexceptionable. At the last meeting of the Gas Committee of the Corporation, the subject of burners was introduced, but not half enough was made of it. Nothing is more certain than that if the consumers in Glasgow do not obtain sufficient light, the fault is not in the gas. It is curious and instructive to remark that in Scottish cities and towns supplied with from twenty-five to thirty-candle gas, we find exactly the same complaints as are made here in the south, where from twelve to sixteen candle gas is supplied. Nothing, however, will satisfy some people. For instance, the Maidstone Gas Company furnish fifteen and a half candle gas, while they might send out twelve-candle gas, and charge a much higher price than they at present receive. And yet Mr. Wells, the apt pupil of an "eminent" gas engineer, is not satisfied. The Maidstone Local Board, it seems, have appointed an "analyst," whose last report was that the gas had the illuminating power of 15·72 candles; but the Board do not seem to understand what are the duties of the officer they have appointed, so they have directed their clerk to ascertain and report.—*London Journal of Gas Lighting.*

A Queer Suit.

DAMAGES CLAIMED FOR INJURIES RECEIVED FROM AN EXPLOSION AT A POPULAR LECTURE.

The San Francisco *Post* of April 20 says: "Since Monday last the case of W. L. Urton vs. Thomas Price has been on trial before a jury in the Fourth District Court. The cause of action dates back to the 10th of September, 1870. On that evening Prof. Thomas Price, the defendant, was engaged in delivering a lecture before a large audience in Corinthian Hall, on the subject of "Illuminating Gases." The lecture was conducted under the auspices of the Mechanics' Institute. Practical tests of various illuminating gases were made to illustrate their brilliancy and adaptability for everyday use. One of these experiments consisted of the passage of pure oxygen

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FRIDAY, JUNE 2, 1876.

over naptha, or gasoline, confined in a small glass vessel, technically called a wolf bottle. The oxygen was forced into the wolf bottle through a tube connecting with a large rubber bag by artificial pressure. In the bottle it mixed with the hydrocarbon produced by the evaporation of the naphtha at the temperature of the surrounding atmosphere, and then passed out through another tube to the glass burner where it was ignited. The apparatus employed was placed on a long table in front of the lecturer, and in full view of the audience. The oxygen had been turned on, and the jet lighted. The flame it produced was one of remarkable brilliancy. The lecturer described it as the illuminating gas of the future, if some way could only be devised for producing pure oxygen cheaply. Soon after the heat of the flame began to affect the glass burner, and the flame changed from a brilliant white to a beautiful orange, and the delighted audience applauded heartily. In a brief period after this change an explosion ensued, scattering the glass bottle and tubes into numberless fragments, while the contents blazed up in a sheet of flame reaching to the ceiling of the hall. Prof. Price's face, neck, and hands were badly burned by the flames and cut by the broken glass, and the face of his assistant, John Roach, was cut and burned in a similar manner. A scene of indescribable confusion followed, accompanied with cries of 'Fire!' The evaporation of naphtha, however, being hastened by the increased heat of the flame, it soon subsided without doing any injury. W. L. Urton, the plaintiff in the case, was an interested auditor at the lecture, and occupied a seat adjacent to the platform. One of the pieces of flying glass struck him in the eye. The injured orb was consequently taken out. The action was brought against Prof. Price for the recovery of $25,000 damages for the loss of his eye, the disfigurement resulting therefrom and the injury to his feelings, on the ground that the experiment had not been performed with ordinary care. The original complaint was filled very soon after the event, Thomas Price being made sole defendant. The defendant in his answer denied that the explosion was the result of negligence, but simply an unavoidable accident. Subsequently, the plaintiff obtained leave to amend his complaint by making the Mechanic's Institute co-defendant. The case was afterward regularly continued until the present time. When it finally came to trial, on motion of the plaintiff the name of the Mechanic's Institute as co-defendant was dropped, and Prof. Price became once more sole defendant. It transpired during the progress of the trial that the Mechanic's Institute had compromised with the plaintiff Urton, by paying him the sum of $500 in satisfaction of damages against it and dismissal of the suit. A motion by defendant's counsel to dismiss the case on that showing was denied by Judge Morrison, who preferred that the testimony should be first taken, so that whatever action the Supreme Court should take on it, in case appealed to, a second trial would not be necessary. The testimony of Rev. Father Neri, Prof. Becker, of the University of California, and Prof. Price, the defendant, was an interesting lecture on the science of chemistry, embracing the properties of various gases and metals. The testimony was closed yesterday morning, and the argument of counsel was concluded last evening. This morning Judge Morrison instructed the jury. At 2 o'clock the jury came into court with the following findings: That the defendant was the servant of the Mechanic's Institute, and not responsible; that he had not used all the precautions against accident now known. On the latter point the court sent the jury back to determine whether the defendant had or had not used all the precautions against accident known at that time. Up to the hour of going to press the jury had not agreed on this point. So far as damagers are concerned the verdict is for the defendant.—*New York Times.*

U. S. Centennial Commission.—International Exhibition, 1876, Philadelphia.

BUREAU OF MEDICAL SERVICE.

Owing to the very large number of persons who contemplate a visit to Philadelphia during the coming summer, it seems important that the utmost publicity should be given to all facts bearing on the sanitary condition of the city.

The following statistics, which have been obtained from the most authentic sources accessible, represent the mortality in some of the chief cities of the world during the past four or five years:

	No. of Years.	Average Population	Av'ge Total Mortality.	Average Death rate per Thousand.
Vienna.....	5	648,560	20,424	31.42
New York....	5	994,458	29,601	29.93
Berlin.....	4	950,000	28,420	29.91
London	5	3,284,488	76,741	23.23
Paris.....	4	1,851,792	42,724	23.06
Philadelphia..	5	744,831	16,573	22.27

While thus showing an average rate of mortality more favorable than that found in any other city containing over 500,000 inhabitants, Philadelphia has recently (1874) attained a degree of healthfulness almost unparalleled, viz.: with a population at that time of 775,000, the number of deaths was but 14,966, giving a death rate of only 19.3 per thousand. These very favorable results are largely due to the abundant and cheap water supply, and to the opportunities given, even to the poorest citizens, for the enjoyment of pure country air in the great Fairmount Park, which contains 2991 acres The extent to which this is valued by the citizens may be inferred from the fact that during the year 1875, the Park was visited by over eleven million persons.

The most powerful influence of all, however, is the absence of that crowding of the population, which is the most fruitful source of sickness and death in many quarters of nearly all other large cities. This will be more clearly comprehended when it is remembered that the 817,488 inhabitants of Philadelphia are spread over an area of 129½ square miles, which are traversed by more than one thousand miles of streets and roads; and that the city contains, in addition to other kinds of buildings, 143,000 dwelling-houses occupied by families—a number exceeding by over 40,000 that of any other city in America.

The climate of Philadelphia is also, a favorable one, although presenting many of the peculiarities common to inland localities. The mean annual temperature of the last ten years is 53.73° Fahr,; the average annual rain-fall is about forty-five inches.

The following table exhibits the mean temperature of each month for the past ten years, showing that the range is far less extreme than is found in many other less favorably situated localities:

January.....	32.72° Fahr.
February.....	33.12 "
March.....	39.16 "
April	53.36 "
May.....	63.24 "
June	73.54 "
July.....	78.74 "
August	72 92 "
September	67.72 "
October.....	56.03 "
November.....	43.34 "
December.....	33.92 "

It is thus seen that only during the months of June, July, and August does the mean temperature rise to a high point. During this period there are very rarely any prevailing epidemic diseases; and the chief mortality occurs among children, especially among the poorer classes.

The health of Philadelphia at present is unusually good. Timely efforts have been made to secure an abundant water-supply to meet the great increase in the demand which must be expected this summer as compared with previous years. Constant watchfulness will be exercised by the authorities to maintain cleanliness, and to avoid or remove every possible cause of disease.

Within the Exhibition grounds a rigid sanitary inspection will be maintained, under the control of the Bureau of Medical Service; and thus a guarantee will be afforded that no cause of infection or disease will be allowed to occur through neglect of this important duty.

The object of this circular has been to call attention to the unusual sanitary advantages of Philadelphia, and to the preparations which have been made to ensure the highest possible degree of healthfulness during the approaching Exhibition season. It is proposed to issue at certain intervals other circulars, announcing in an official and accurate manner the sanitary condition of the city, so that entire security may be felt by all who desire to visit the Centennial International Exhibition.

WILLIAM PEPPER, M. D.,
April 15, 1876. Medical Director.

Experiments with Dynamite.

On a recent day a number of very interesting experiments with dynamite were shown at the works of the British Dynamite Company, at Ardeer, near Stevenston. It was shown that dynamite can with ordinary precautions be handled with safety, and that the restrictions upon its transport are too stringent, and might be relaxed to a considerable extent. A large box, containing 50 lbs. was smashed to atoms by violent concussion, and no disastrous results followed. Naked lights were applied to the substance, but these had no other effect than to set it on fire without any explosion taking place. The Clay Cross Company's Limestone Quarries, at Crick, near Ambergate, were the scene last week of some very interesting experiments with dynamite. The first test given was a very strong hole, 2 feet 6 inches deep, bored in a piece of stone, tightly keyed in the bottom of the quarry. The hole, having previously been twice charged with gunpowder, to no purpose whatever, was considered to be a very tough one. The hole was charged with three dynamite cartridges and fired, the result being that the keystone was shattered to pieces. The company then adjourned to a ledge of solid stone about 14 feet thick. It was suggested, to illustrate the relative power of gunpowder and dynamite, that one of the holes, which were on an average 6 feet deep, should be charged with powder. It was also decided to take notice of the time taken up by the two workmen in charging their holes. Eight dynam-

ite cartridges were introduced, followed by a primer cartridge, which contained detonator and fuse. The workman then caught hold of a bucket of water close by, poured it into the hole on the top of the charge and pronounced the hole stemmed ready for firing, the whole time being one minute. At this period the powder hole was being hard stemmed with quarry dirt, the exact time taken up in charging being six minutes. The dynamite hole was fired first. In a short time the charge exploded, bringing down an enormous quantity of stone, which may be judged from the fact that about 10 feet from the hole charged with dynamite, was another hole prepared as a second test, but the dynamite had done its work so well that it brought down nearly the whole of the stone allotted to the two tests. The powder hole was then fired, which cracked the surface and brought down several tons of stone, the result not bearing comparison with the former shot.—*Iron.*

Construction of Wooden Buildings.

It is pleasent to note the position assumed by Mayor Stockley of Philadelphia, in vetoing an ordinance of the city passed to allow, by special permission, the construction of a wooden building within the prohibited limits; and this on account not only of the dangers of special legislation, which is a question of politics, but of the constant pressure to evade or set aside the building-laws of cities, which is a matter for architects to consider. Building laws have been passed in most of our largest cities; but there has always been a steady resistance to their enactment, and to the enforcement of them after they are enacted.

In a quick-moving community like those of most American cities, it is hard to persuade people to pospone a temporary profit to a permanent gain; and the proportion of their capital which most people are willing to withdraw from the business in which they hope to "turn it over" rapidly, to put it into buildings, is much less than is common in Europe. Nevertheless the most stringent building-laws that it has been found possible to put in force in this country would seem very loose and inadequate in most Continental cities. The humblest French or Italian proprietor, who will build him a house, would disdain a wooden one, and build it with walls of solid masonry, so that it shall not burn; and, rude as it may be, it shall be strong enough to house his decendants for a couple of centuries. But we, who are believed to earn a larger surplus of our absolute needs than any other people on earth, are content to live in houses, because they are cheap, that will burn up in an hour, and perhaps carry half a city with them, or of which, if they are spared from fire, decay makes an end in a generation. The mayor of Philadelphia has once before vetoed a special ordinance of the same kind, which, however, was re-enacted over his head; and he has since, as he says in his message, let several of them pass, rather than seem to put himself in permanent opposition to the city councils; but this last proposition to build a wooden shanty in a prominent thoroughfare seemed flagrant enough to lead him once more to take a decided stand.—*American Architect and Building News.*

Price of Gas.

The following prices are *official*, having been furnished to the AMERICAN GAS-LIGHT JOURNAL by the officers of the various Gas Companies.

Albany (Peoples) N. Y.	$2.75	
Annapolis, Md.	3.40	
Atchison, Kansas.	4.50	
Austin, Texas.	6.00	
Allegheny City, Pa.	1.80	20 p. ct. off prompt pay
Albany, N. Y.	2.75	
Ashland, Ohio	3.50	Street lamps 4½ hours 17 nights per month, $15 per annum.
Augusta, Ga.	4.00	Net.
Anderson, Ind.	3.50	Crude petroleum.
Ashtabula, Ohio	2.00	Wren's process; $10 for 80 candle gas.
Auburn, N Y.	3.50	5 p c off prompt pay.
Allentown, Pa.	2.50	$18 per an street lamps Meter rent 10 cents per month.
Ashland, Pa.	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Brooklyn, B'klyn.	2.75	
" Citizens.	2.75	
" Nassau.	2.75	
" Metropol'an	2.75	
" Peoples.	2.75	
" W'msburgh	2.75	
Brockton, Mass.	3.80	
Batavia, N: Y.	3.00	
Bridgton, N. J.	3.50	
Bangor, Me.	3.00	
Boonville, Mo.	4.50	
Brownsville, Tenn.	4.50	
Belfast, Maine	4.00	10 p. c. off bills over $10; 5 p. c. off bills under $10.
Brockville, Ontario	3.75	
Bloomfield, N. J.	3.75	
Belleville, Ill.	3.50	
Bellaire, Ohio	2.85	5 p ct. off prompt pay.
Barnesville, Ohio	3.00	5 p ct. off prompt pay. Street lamps $17.50 per ann. Burn till 12 P. M. on moonless nights.
Boston, Mass.	2.25	
Bath, Maine	4.00	12½ p c off prompt pay.
Bayonne City, N. J.	4.00	Net.
Binghampton, N. Y.	4.00	10 p c off prompt pay on bills for 1000 per month.
Buffalo G L Co., N Y.	2.50	10 p c off prompt pay.
Buffalo Mutual, N Y.	2.50	10 p c off prompt pay.
Buffalo Citizens, N Y.	2.50	10 p c off prompt pay.
Bloomsburg, Pa.	10.00	70 candle gas, 10 p c off prompt pay. Patton's process.
Cleveland, Peoples, O	2.00	
Cumberland, Md.	3.00	
Charleston, W. Va.	4.00	25 p. ct. off prompt pay Meter rent 25, 30, and 50 cents. per m. for 3, 5 and 10 light.
Cincinnati, Ohio	2.25	
Columbia, Mo.	4.50	
Carondolet, South St. Louis, Mo.	3.00	5 p. ct. off prompt pay,
Chattanooga, Tenn.	3.00	
Cold Water, Mich.	3.25	
Chicago, Ill.	2.50	
Columbia, Pa.	2.85	Lowe process.
Charlottesville, Va.	3.50	Meter rent 20 cents.
Cedar Rapids, Iowa.	4.50	50 cts p M. off prompt pay.
Cairo, Ill.	3.75	50 cts added if not paid by the 5th.
Cortland, N. Y.	4.00	25 cts p M. off prompt pay.
Cairo, Ill.	3.75	50 cents per month off prompt pay. For 20,000 feet a month $2.50.
Chillicothe, Ohio.	3.00	
Camden, N. J.	3.16	5 p c off prompt pay'; 10 p c off for 100,000 per year.
Carson City, Nevada	8.00	Gas from wood and Cannel coal.
Cadiz, Ohio	3.50	10 p c off on 500 feet or less; 50 cts per M. on from 500 to 2000; 20 p c off on 2000 and upwards.
Derby, Conn	3.60	10 p. c. off prompt pay, and 50 cts per M. on excess of 5000 ft. per month.
Decatur, Ill.	3.50	50 cts. per M. added, if not paid by 10th.
Danbury, Conn	4.28	For less than 5000 per month.
" "	3.85	For over 5000 per m th
Dover, Del.	3.60	
Dunkirk, N Y.	2.50	Street lamps till 12, moonless nights $25 per annum.
Defiance, Ohio	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
East Boston, Mass.	3.00	
East St. Louis, Ill.	3.50	5 p. c. off prompt pay.
Evansville, Ind.	3.00	City lamps $30.
Erie, Pa.	3.00	City lamps $28 p. an.
Elkhart, Ind.	3.50	
East Newark, N. J.	4 00	
Eastchester, N. Y.	3.50	
Elizabethtown, N. J.	3.00	
E ast N Y (Union) L I	3.00	
Eastport, Me.	4.00	
Fredericksburg, Va.	3.40	
Flint, Mich.	3.50	
Franklin, Pa.	3.00	
Fall River, Mass.	3.00	
Freeport, Ill.	3.80	
Fort Scott, Kansas.	4.50	
Flatbush, L. I.	3.50	
Guelph, Ontario.	3,50	
Geneva, N, Y.	2.50	5 p. c. off prompt pay. Wood and oil gas.
Greensboro, N. C.	4.00	
Galena, Ill.	4.50	Meter rent 25 cts. per month.
" "	4.00	After September 1st.
Grand Rapiids, Mch.	2.80	For less than 1000 feet per month.
" " "	2.50	For over 1000 eet per month. 10 per ct discount on 300,000 ft annually
Gloucester, N. J.	3.15	5 p c off prompt pay.
Greenwich, Conn.	2.40	Wren's process
Goshen, Ind.	10.00	70 candle gas, 20 p c off prompt pay. Patton's process.
Huntsville, Ala.	3.50	
Hempstead, L. I.	4.00	
Huntingdon, Pa.	3.80	10 per ct. off prompt pay.
Hagerstown, Md.	3.75	
Hamilton, Ohio	4.00	
Hillsdale, Mich.	3.50	
Holyoke, Mass.	3.01	
Hartford, Conn.	2.75	
Hornellsville, N. Y.	3.50	50 cents per 1000 off prompt pay.
Honesdale, Pa.	4.00	12½ cents meter rent per month.
Ithaca, N. Y.	4.00	5 p. c. off prompt pay.
Indianapolis, Ind.	2.50	
Indiana, Pa.	3.00	10 p. c. off prom pay Meter rent 50 cents per month.
Jersey City, N. J.	2.75	
Joliet, Ill.	3.50	
Jacksonville, Ill.	4.00	12½ p.c. off prompt pay.
Jefferson City, New Orleans, La.	4.00	
Johnstown, N Y.	3.50	
Knoxville, Tenn.	3.00	Meter rent 15 cents.
Lyons, N. Y.	4.00	
Lima, Ohio	3.80	
Lynchburgh, Va.	3.00	5 p. ct. added to bills not paid in 5 days.
Louisiana, Mo.	4.50	
La Crosse, Wis.	4.50	50 cents per M. off prompt pay.
Lancaster, Pa.	3.00	
Louisville, Ky.	2.70	5 p. c. off prompt pay.
La Porte, Ind.	3.50	Wood and oil gas.
Lowell, Mass.	2.50	25 cents per 1000 off prompt pay.
Lafayette, Ind.	2.75	
Lexington, Mass.	2-40	Wren's process.
Millville, N. J.	3.12	
Milford, Del.	3-50	
Marquette, Mich.	3.50	
Morris, Ill.	2.00	For 15 candle power, or $10 per M. coal gas meter measure (Petroleum Gas—Wren's patent).
Meriden, Conn.	3.93	
Marietta, Ohio.	3.50	20 cts. per M. off if paid by 6th. Consumers over 3000 ft. 30 cts. additional discount.
Marshalltown, Iowa.	4.50	50 cts p M. off prompt pay.
Meadville, Pa.	3.50	25 cts p M. off prompt pay.
" "	2.50	For over 10,000 ft. per month,
Monroe, Mich.	3.50	5 per ct off prompt pay
Malone, N. Y.	4.50	
Middletown, Conn.	3.56	Net.
Madison, Ind.	3.75	25 p c off if paid in five days: 25 to 40 cents per month meter rent.
Mount Sterling, Ky.	4.50	
Monongahela, Pa.	2.75	Under 5000 feet m'th $2.75 per M.; over 5000 feet per month $2.50 per M.
Minneapolis, Minn.	5.00	10 p c off prompt pay.
Mahanoy City, Pa.	10.00	70 candle; 20 p c off prompt pay. Patton's process.

Morristown, Pa.	3.00	18 candle coal, and o il.
New York, New York.	2.50	
" " Harlem	2.75	
" " Manhattan	2.50	
" " Mutual	2.50	
" " Mropolitan	2.50	
" " Municipal.	2.50	Water Gas.
Nashville, Tenn.	2.85	
Newark, Citizens, N.J.	3.00	5 p. c. off prompt pay.
Norfolk, Va.	3.10	
New Brunswick, N. J.	2.70	
Newton, N. J.	4.00	
North Attleboro, Mass.	3.50	
New Britain, Conn.	3.70	
New Haven, Conn.	2.75	
Nantucket, Mass.	3.00	Meter rent 15 cts. p. m.
Newark, N. J.	2.85	
Niagara Falls, N. Y.	3.50	20 cts p M. off prompt pay.
Norwalk, Conn.	4.00	12½ p ct off prompt pay.
New Albany. Ind.	3.00	
Oswego N. Y.	3.15	5 p. c. off prompt pay.
Ottawa, Ill.	4.00	12½ p. c. off promptpay
Omaha, Nebraska	5.00	
P'keepsie, Citizens	2.70	Gwynne Harris process
Paterson, N. J.	3.80	10 p c. off prompt pay, and in addition 5 p.c. on bills of $200; 10 p. c. on bills of $1000
Portchester, N. Y.	3.50	
Pittsfield, Mass.	3.50	5 p. c. off prompt pay, and 10 p. c. off on bills of $350 per an.
Portland, Me.	3.00	
Paris, Ky.	4.50	Meter rent 25 cts. p m.
Portsmouth, N. H.	3.22	
Pittsburgh, Pa.	1.00	
Philadelphia, Pa.	2.15	
Painesville, Ohio	3.50	
Pawtucket, R. I.	3.00	Over a million feet a year $2.70.
Providence, R. I.	2.25	
Pottsville, Pa.	3.50	10 p ct off prompt pay.
Plainfield, N. J.	3.50	5 p ct off for less than 5000 a month. 10 per cent more than 5000 a month.
Peoria, Ill.	3.50	
Paducah, Ky.	4.00	10 p c off prompt pay.
Plymouth, Pa.	10.00	70 candle. Patton's process.
Pottstown, Pa.	3.20	Public lamps till 11 P. M., 18 nights per month $20 per lamp.
Poughkeepsie, N Y.	2.60	10 p c off prompt pay.
Quincy, Citizens, Mass.	5.00	
Quincy, Ill.	3.50	
Quebec, Ont.	2.40	
Rome, N. Y.	3.60	
Rochester, N. Y.	3.00	
" Citizens	3.00	
Rondout, N. Y.	3.60	
Rockford, Ill.	4.00	5 p c off prompt pay; 10 to 25 p c off on bills for 500 to 25 M, feet per month.
Richmond, Ind.	3.00	50 cents added if not paid by 20th.
Syracuse, N. Y.	2.75	
Springfield, Ill.	3.25	$25 for city lamps.
St. Joseph, Mo.	4.00	12½ p. ct. off on bills over $100 p. month.
St. Albans, Vt.	5.00	10 p. c. off prompt pay, and in addition 5 p. c. off bills from $50 to $100 per month; 10 per. ct. off bills over $100.
Sandusky, Ohio	3.00	
Saratoga, N. Y.	5.00	20 p. c. off prompt pay, Nov. 1st to May 1st. 10 p. c. rest of year.
San Antonio, Texas	7.00	10 per ct off from 10 to 20,000 per month 20 p ct off from 20,000 and upwards.
St. Charles, Mo.	4.50	
Sidney, Ohio	3.25	
Steubenville, Ohio	2.50	
Sherman, Texas	5.00	5, 10, 15 and 20 p. c. off, according to quantity.
Salem, Oregon	7.00	October last reduced from $8.
Salem, Ohio	2.75	Meter rent 12½ cts if 300 feet is not used monthly
Sedalia, Mo.	3.50	
Sharon, Pa.	3.15	5 per ct off on less than 5000 feet per month. 10 p ct from 5 to 15 M. 15 p ct from 15 to 20 M. 20 per ct over 40 M.
Shreveport, La.	5.00	
Shelbyville, Ind.	2.00	Wren's process; $10 for 80 candle gas.
Shenandoah, Pa.	10·00	70 candle. Patton's process.
Shamokin, Pa.	10.00	70 candle. Patton's process.
Sunbury, Pa.	10.00	70 candle. Patton's process.
Tiffin, Ohio.	3.00	
Titusville, Pa.	3.00	
Tidioute, Pa.	2.00	Wren's process.
Vicksburgh, Miss.	4.50	
Wilkesbarre, Pa.	3 50	10 p. c. off prompt pay.
Worcester, Mass.	3.00	5 p. c. off on $500, and 10 p. c. off on $1000 in six months.
Westfield, N. Y.	4.00	10 p. c. off prompt pay.
Washington, D. C.	2.25	
Watertown, N. Y.	4.50	10 p. c. off prompt pay.
Wheeling, West Va.	2.25	10 p ct off prompt pay.
Washington, Pa.	2.50	
Woburn, Mass.	3.00	
Waterbury, Conn.	3.50	5 p c off on biils of $50 10 p c off on bills of $100. 5 p c added if not paid by 10th.
York, Pa.	3.00	Meter rent 12½ cents.
Youngstown, Ohio	2.50	10 p. c. off on bills of $50 per month.
Waterbury, Conn	3.00	5 p c off on bills of $50, 10 p c off on bills of $100; 10 p c added if not paid by 10th.
Washington, C H., O.	1.20	Wren's process; $6 for 80 candle gas.
Wilmington, Del.	2.50	Street lamps 3,650 hrs per year, $31.50 per lamp.
Zanesville, Ohio.	2.70	10 p. c. off on bills of $25 per month; city lamps $23.

Gas Stocks.

Quotations by W. R. Scott & Co., Bankers,

24 Pine Street, New York City.

June 2, 1876.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Harlem	$1,850,000	50	120	122
Manhattan	4,000,000	50	250	255
Metropolitan	2,500,000	100	145	150
" Scrip	$1,000,000	..	102	—
" Bonds.	500,000	1000	104	—
Mutual	5,000,000	100	110	112
" Bonds, gold.	900,000	1000	105	—
New York	4,000,000	100	140	145
Central, Westchester	466,000	50	100	105

Gas Co.'s of Brooklyn.

Brooklyn	2,000,000	25	190	195
Citizens	1,200,000	20	90	95
" Scrip	320,000	1000	95	100
Peoples	1,000,000	10	60	65
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	85	—
Metropolitan	1,000,000	100	75	80
Nassau	1,000,000	25	90	95
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	125	130
" Scrip		...	100	103

Out of Town Gas Companies.

Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	—	80
" Bonds	200,000	1000	—	90
Baltimore, Md.	2,000,000	100	—	180
" Ctfs., gold	1,000,000		105	—
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark	918,000	50	87½	—
" " Ctfs.	53,000	—	—	—
" " Bds.	124,000	—	—	—
Derby of Conn.	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind.		100	...	—
Hannibal, Mo.	100,000	100	95	100
Hartford, Conn.	700,000	25	152	—
Hempstead, L	25,000	100	...	—
Jersey City	386,000	20	160	170
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown, Maine	400,000	100	50	85
Lima, Ohio	60,000	100	85	...
" Bonds	30,000			
Laclede, St Louis Mo	1,200,000	100	—	115
Peoples, Jersey City		...	125	135
Peoples of Albany	650,000	100	—	25
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	101	102
" Bonds			106	—
Rochester, N. Y.		100	50	60
Richmond Co., S. I.	300,000	...	100	105
Woonsocket, R. I.	150,000	100	100	...
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	112½	
San Francisco Gas-Co., S. Fr'isco Cal.			99	100
St. Louis, Missouri	600,000	50	110	130
Stillwater, Minn.	50,000	50	—	26
Suburban, W'stch'str	390,000	50	—	100
Troy, Citizens	600,000	100	—	100

PRICES OF FOREIGN AND DOMESTIC GAS COALS.

[Reported Expressly for this Journal.]

June 2, 1876.

DELIVERED IN NEW YORK.

English Cannel.

Ince Hall	$17 00	@	18 00
Kirkless Hall	16 50	@	17 00

English Caking Coals.

Newcastle Gas	$5 50	@	00 00
Liverpool caking	11 50	@	12 00

British Province Coals.

Pictou	2 00
Block House—At Mines, $1.87, Gold	2 00
Caledonia—At Mines, $1.50, Gold	0 00
Little Glace Bay—At Mines, $1.75, Gold	0 00
Lingan—At Mines, $1.75. Gold	0 00
Sydney—Old Mine	3 00
" Reserve, $1.75, GoldMine	0 00
" International	— —

Duty, 15 cents per ton, gold. Freight to New York $2 00 currency. Cost of above coals delivered in New York, $4 75 @ $5 00, currency.)

Pennsylvania Coals.

Penn Gas Coal—At Amboy	$5 60	@	0 00
Westmoreland—At Amboy	5 60	@	0 00
Shafton	5 60	@	0 00
(In New York, the above coals $6 00)			
Youghiogheny	6 00	@	0 00
Waverly	6 00	@	0 00

West Virginia Coals.

MurphyRun	6 50	@	0 00
Despard	6 50	@	0 00
West Fairmont	6 50	@	0 00
American Gas Coal	7 40	@	0 00
Fairmont	6 50	@	0 00
Newburgh Orrel	6 50	@	0 00
Pinnickinick	6 50	@	0 00
Cloverhill of Virginia	6 00	@	6 50
McKenzie Compound Mixture			— —

American Cannel Coals.

Peytona of West Virginia	$12 50	@	00 00
Darlington of Pennsylvania			— —
Cannelton Cannel			11 00
Red Bank—at Philadelphia			6 50
" —at South Amboy			7 25

Asphalts.

Albertite of New Brunswick	$21 00	@	— 00
Trinidad Bitumen	— —	@	14 00

The Penn Gas Coal Company have contracted with the PittsburghGas-Light Co. for their entire supply for th ensuing year from their Youghiogheny mines.

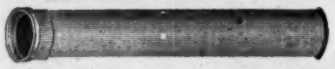
Within the last week contracts have been made by some of the companies in New York for about 200,000 tons of Penn Westmoreland, Waverly, Youghiogheny, and the West Virginia caking coals—at $6 00 per ton a reduction of 50 cents from last years' prices.

JAMES MARSHALL & CO.

Franklin Foundry and Pipe Works,

MANUFACTURERS OF

GAS, WATER, AND OIL PIPES,



Works, 18th, 19th, 20th and Railroad Street.
Office, No. 23 Nineteenth Street.
Pittsburgh, Pa.

Pipes from 3-inch and upwards cast in 12 ft. lengths.

☞ Send for Circular and Price List

Brooklyn Clay Retort

AND

FIRE-BRICK WORKS,

VAN DYKE STREET, BROOKLYN, N. Y.

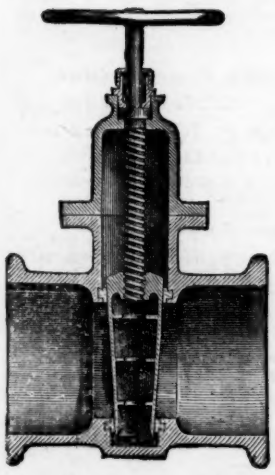
EDWARD D. WHITE, Surviving Partner of the late firm J. K BRICK & CO. 402-1y

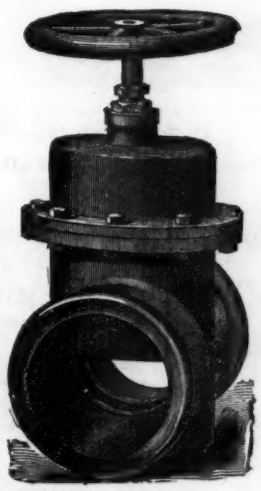
CHAPMAN VALVE MANUFACTURING CO.

MANUFACTURERS OF

CHAPMAN GAS VALVES.

Office and Sales Room 75 and 77 Kilby Street, Boston.





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The Best Gas Valves Ever Made.

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357-tf

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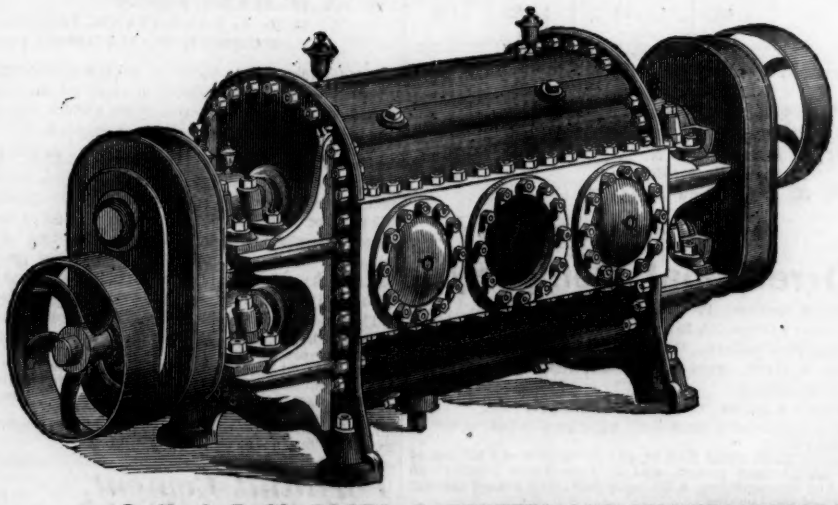

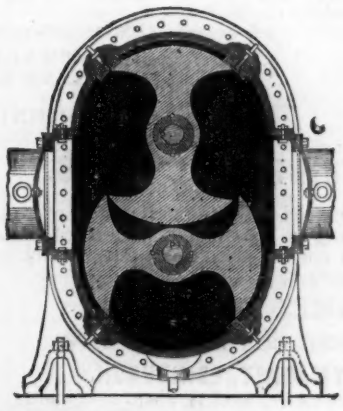

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We build them of any required capacity, large or small, adapted to any kind of works or place.

Send for Illustrated Catalogue, giving all particulars as to capacity, speed, power required, dimensions, and price of each size and references to parties using them.

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cknowledged to be the most valuable ENRICHER produced in this country, a gross ton yielding 10,000 ubic feet of GAS of 64·54 CANDLE POWER; COKE 32 bushels, of good quality.

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Volatile Matter.	Coke.	Per cent. of Ash in		Sulphur in			Specif. Gravity.	
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MAXIMUM YIELD, 5.06 cubic feet of Gas per pound of Coal—A yield of 4·78 cubic feet per lb.. —gave 16 14-100 Candle-Power.

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Gentlemen of the profession:—As your consumers demand a better light, and as that demand has been in many cases sought in vain to be met by using different abortive imitations of my various processes, would it not be well to make success sure by trying the plan of the inventor.

You can enrich your Coal Gas to any desired standard, by using my process, in the simplest manner, and much cheaper than by *any other* method. Address as above. 397

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It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

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Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

294-1y n

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OFFER THEIR SUPERIOR

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To Gas Light Companies throughout the country.

Agents, PARMELEE BROTHERS, No. 32 Pine street, N. Y.

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This process has been fully tested nearly 50,000,000 cubic feet of Gas having been made under it, and fully demonstrating the fact that it is the greatest improvement ever made in the manufacture of Gas, either for Lighting or Heating purposes. With half a ton of Anthracite Coal 150,000 cubic feet of Gas per day is made from three benches, and the labor is so small that one man can attend three or four benches.

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355-

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DOUBLE SCREENED,

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The facilities of the WAVERLY COMPANY are unsurpassed by those of any other Company on the Youghiogheny.

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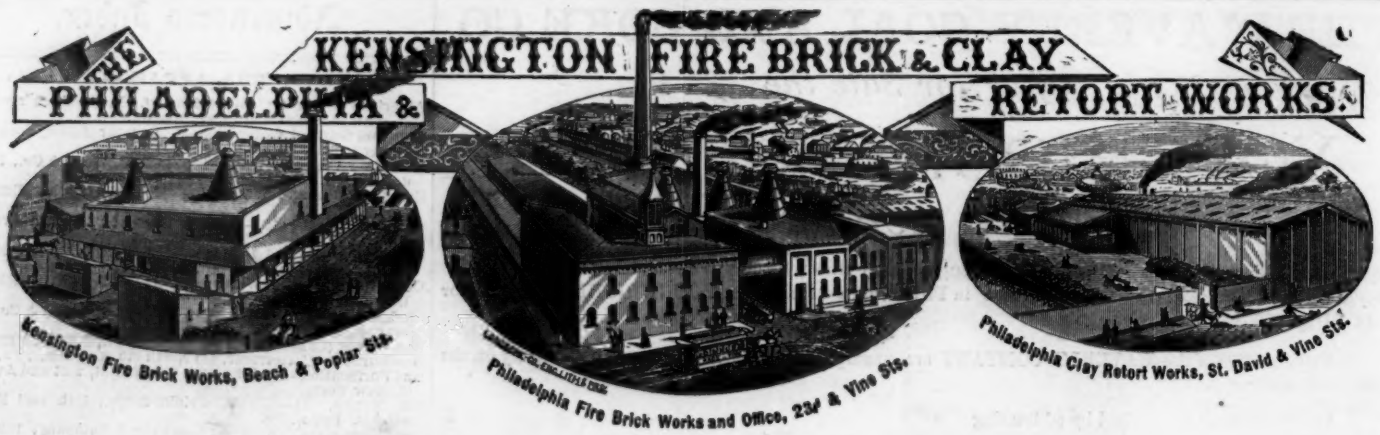
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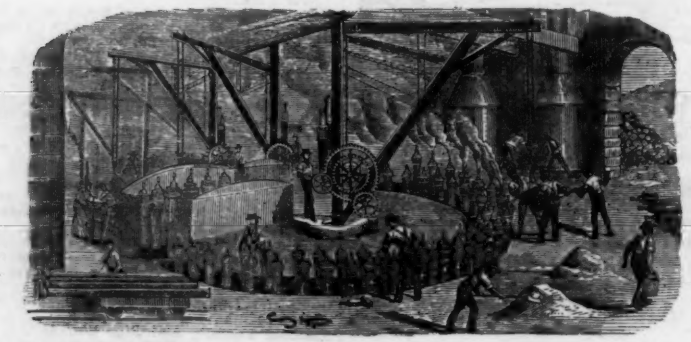

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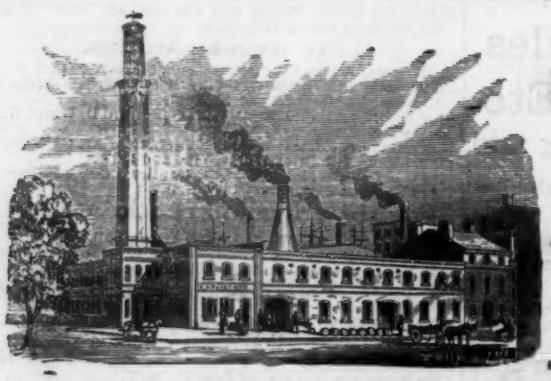

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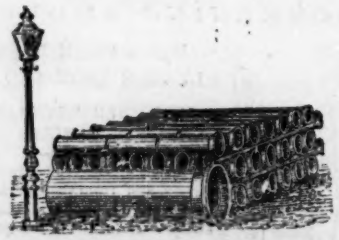

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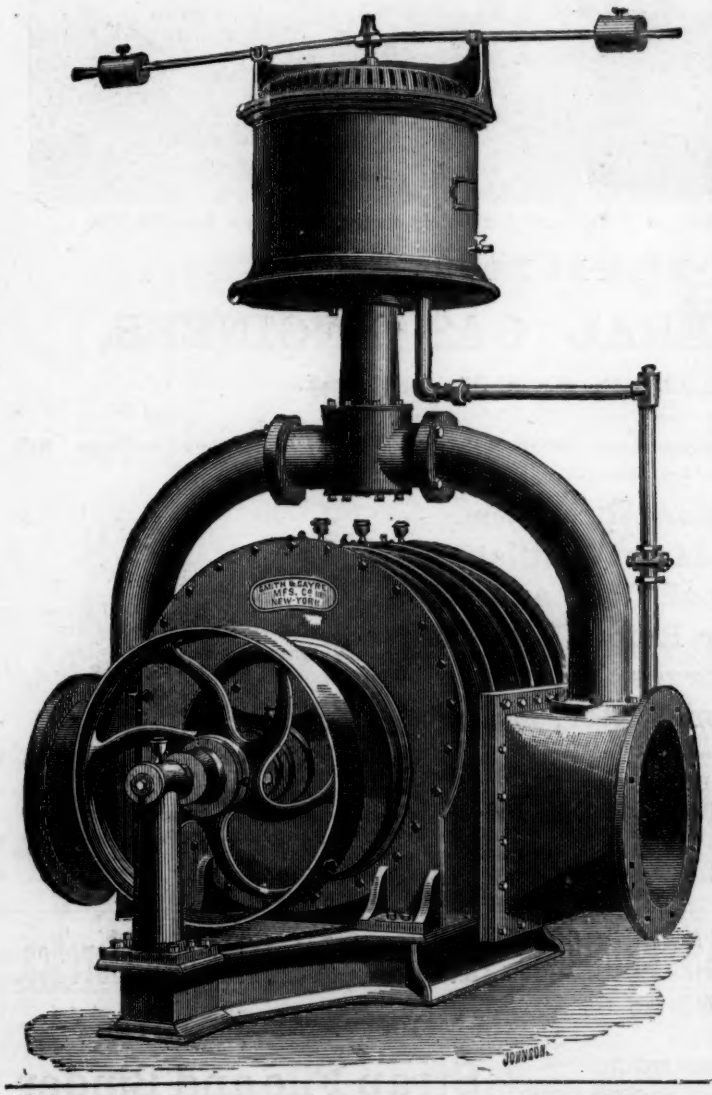

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The Blower is a Force Blast machine, durably built, and can be driven with one-third the power required to drive the ordinary fan

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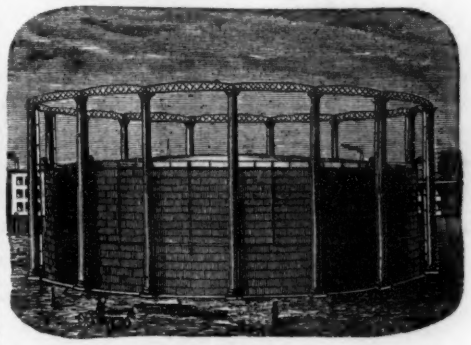

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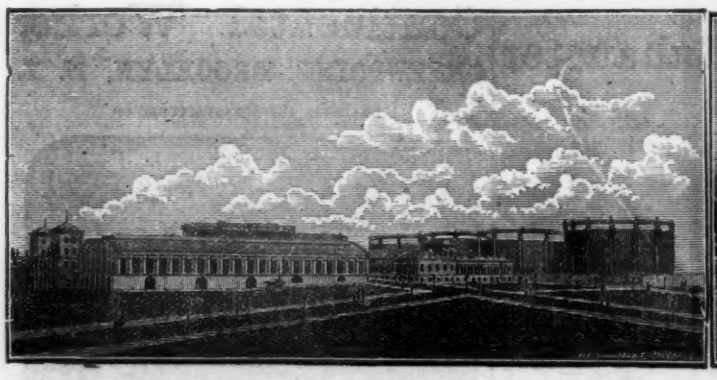

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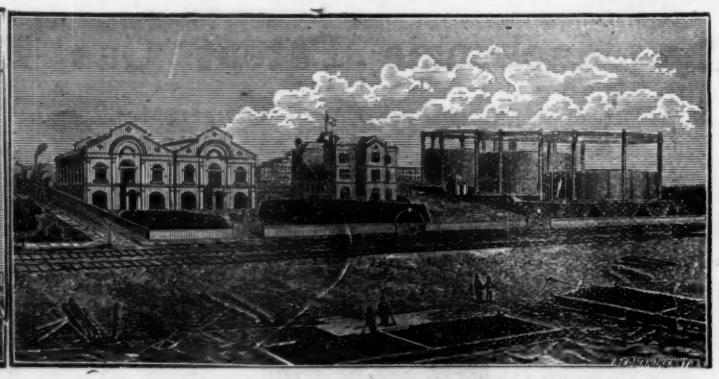

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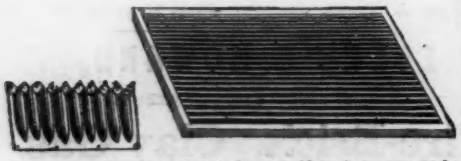

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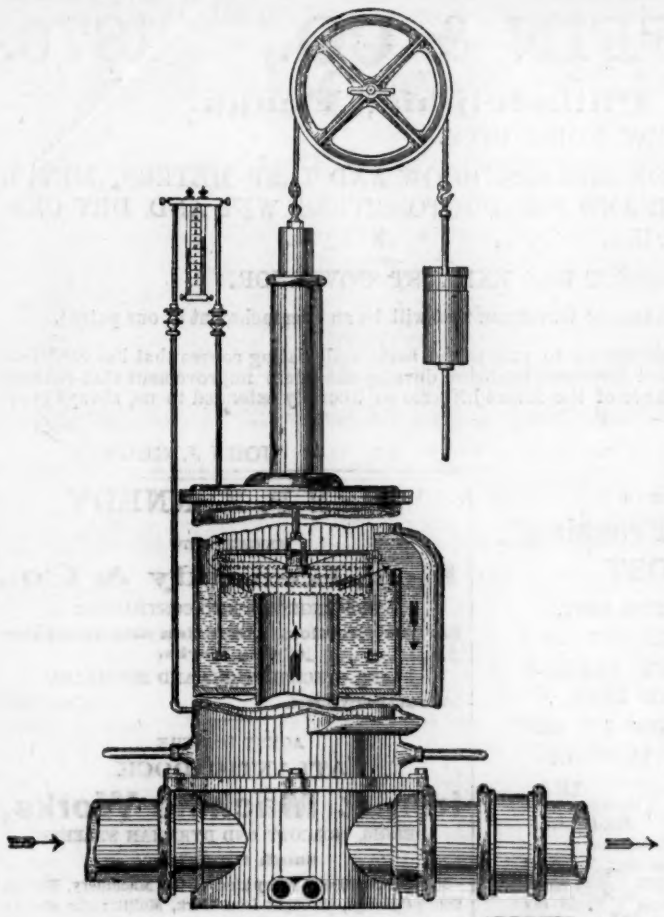

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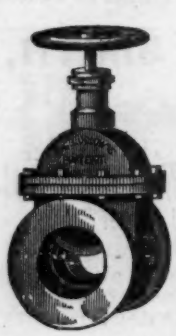

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